DISCRETE SEMICONDUCTORS

Microwave transistors

BOOK SC15 1990

Philips Components

PHILIPS

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MICROWAVE TRANSISTORS

SELECTION GUIDE

(Maintenance types not included)

1. Radar pulsed power transistors

1.1 L-band

type	f GHz	V_{CC} V	t_p μs	at δ %	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 μs	at δ %	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 μs	δ %	P_L W	G_p dB	η_C %	page
MRB11175Y	1.09	50	10	1	$\geq$ 175	$\geq$ 7.5	$>$ 35	161
MRB11350Y	1.09	50	10	1	$\geq$ 350	$\geq$ 7	$\geq$ 30	165
MSB11900Y	1.09	50	10	1	$\geq$ 800	$\geq$ 7	$\geq$ 30	169
MZ0912B50Y	0.960 - 1.215	50	10	10	$\geq$ 50	$\geq$ 7	$\geq$ 42	173
MZ0912B100Y	0.960 - 1.215	50	10	10	$\geq$ 100	$\geq$ 7	$\geq$ 42	181
MX0912B250Y	0.960 - 1.215	50	10	10	$\geq$ 235	$\geq$ 7	$\geq$ 42	189
MX0912B350Y	0.960 - 1.215	50	10	10	$\geq$ 325	$\geq$ 7	$\geq$ 40	197
RZB12050Y	1.09	50	100	10	$\geq$ 35	$\geq$ 7	$\geq$ 30	377
RZB12100Y	1.09	50	100	10	$\geq$ 80	$\geq$ 7	$\geq$ 30	381
RZB12250Y	1.09	50	100	10	$\geq$ 200	$\geq$ 7	$\geq$ 30	385
RXB12350Y	1.09	50	100	10	$\geq$ 300	$\geq$ 7	$\geq$ 30	313
RX1011B350Y	1.03 - 1.09	50	300	10	$\geq$ 300	$\geq$ 7	$\geq$ 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.

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 μs; δ = 10%.
(2) Measured under pulsed condition t_p = 300 μs; δ = 10%.
(3) Measured under pulsed condition t_p = 150 μs; δ = 5%.
(4) Measured under pulsed condition t_p = 1 ms; δ = 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
R7	LAE6000Q
R8	LAE4001R
R9	LAE4002S
104	LJE42002T
146	LKE21004R
190	LKE21050T
196	LTE42008R
198	LTE42012R
383	PQC5001T
395	PPC5001T
400	LUE2003S
401	LUE2009S
407	LBE2003S
408	LCE2009S
409	LBE2009S
411	LWE2015R
413	LWE2025R
430	LV2931E50S
435	LTE21009R
436	LTE210015R
439	LTE21025R
502	LTE42005S

Marking code	Type number
1005M	PKB12005U
2301X	PTB23001X
2303X	PTB23003X
2305X	PTB23005X
3201X	PTB32001X
3203X	PTB32003X
3205X	PTB32005X
4002S	LTE4002S
4201X	PTB42001X
4202X	PTB42002X
4203X	PTB42003X
11175Y	MRB11175Y
11350Y	MRB11350Y
3135B5X	RV3135B5X
42004X	PVB42004X
1721E50R	LV1721E50R
2024E45R	LV2024E45R
2327E40R	LV2327E40R

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 x V_{CC})
η_{add}	= power added efficiency (P_{out} - P_{in}) / (I_C x V_{CC})
P_{in}	= input power
P_L	= load power under specified conditions
P_{L1}	= load power for 1 dB compressed power gain
P_{out}	= output power
P_{tot}	= total power dissipation
$R_{th\ j\text{-}c}$	= thermal resistance from junction to case
$R_{th\ j\text{-}mb}$	= thermal resistance from junction to mounting base
$R_{th\ mb\text{-}h}$	= 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
VSWR	= 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
Ø : Number

a) XXX ØØØØX	: transistors without matching cell
b) XXX ØØØØØX	: transistors with input matching cell only (exception type PXB16050U)
c) XX ØØØØXØØX ØØØX	transistors with input and output matching cell (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	

Ø 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%/$^{\circ}$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-96

  They 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-125

  A 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

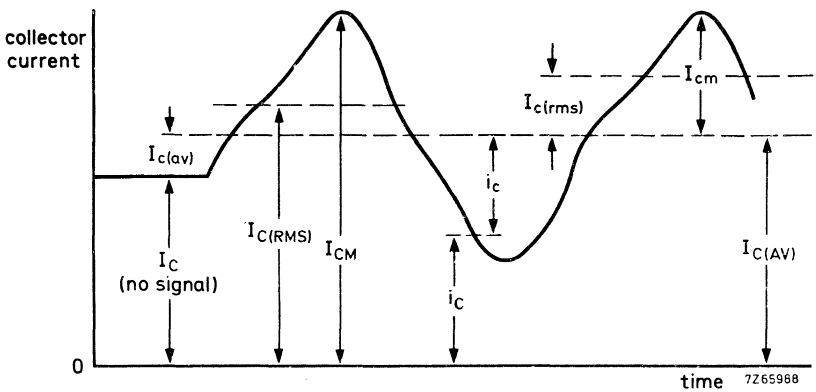
For multiple unit devices, the subscripts are modified by a number preceding the letter subscript; in the case of multiple subscripts, hyphens may be necessary to avoid misunderstanding.

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_f, 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.

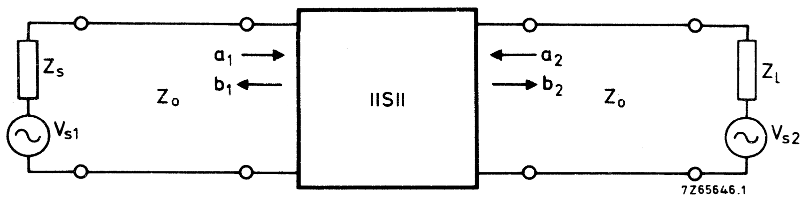
Examples: $Z_i = R_i + jX_i$
$y_{fe} = g_{fe} + jb_{fe}$

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

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

SCATTERING PARAMETERS

In distinction to the conventional h, y and z-parameters, s-parameters relate to travelling 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.



$$a_1 = \frac{V_{i1}}{\sqrt{Z_o}} \qquad a_2 = \frac{V_{i2}}{\sqrt{Z_o}}$$

$$b_1 = \frac{V_{r1}}{\sqrt{Z_o}} \qquad b_2 = \frac{V_{r2}}{\sqrt{Z_o}} \qquad {}^{1)}$$

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

V_i = incident voltage

V_r = reflected (generated) voltage

The four-pole equations for s-parameters are:

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

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

$$s_i = s_{11} = \left.\frac{b_1}{a_1}\right| a_2 = 0$$
$$s_r = s_{12} = \left.\frac{b_1}{a_2}\right| a_1 = 0$$
$$s_f = s_{21} = \left.\frac{b_2}{a_1}\right| a_2 = 0$$
$$s_o = s_{22} = \left.\frac{b_2}{a_2}\right| a_1 = 0$$

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

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

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

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

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

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

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_{case} = 25 °C in a common-emitter class-A circuit

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

MECHANICAL DATA

Dimensions in mm

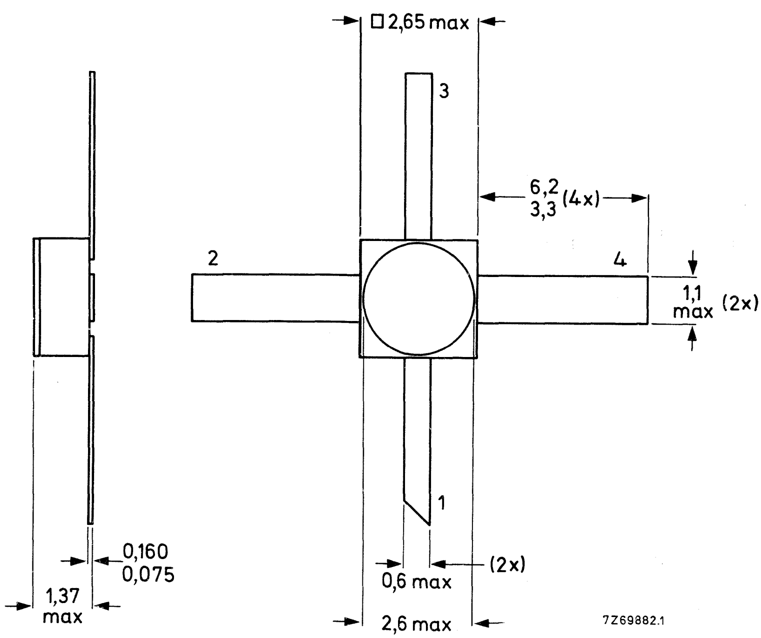
Fig. 1 SOT100.

Emitter connected to metallized lid

Marking code
R8 = LAE4001R

Pinning :

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



RATINGS

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

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

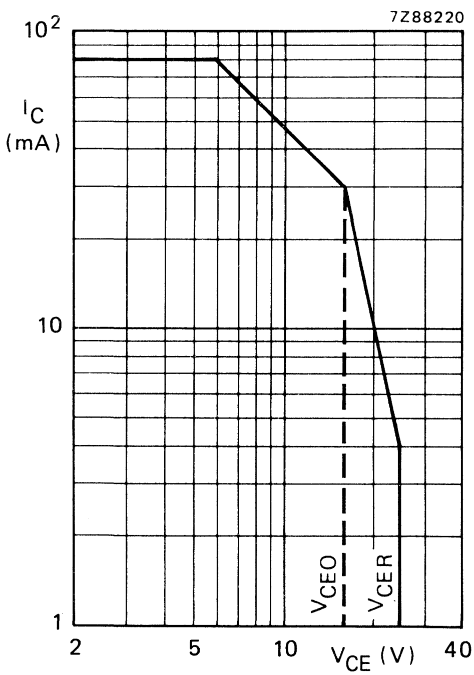


Fig. 2 DC SOAR at $T_{case} \leqslant 100$ °C; $R_{BE} < 220$ Ω.

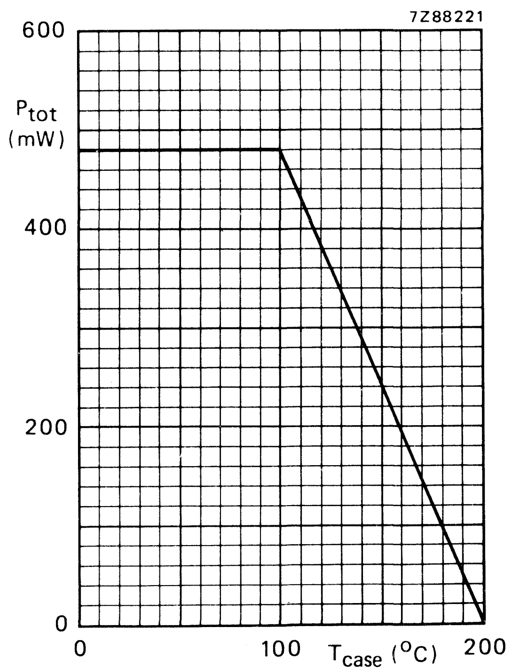


Fig. 3 Power derating curve vs. temperature.

THERMAL RESISTANCE (at T_j = 75 °C)

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

*K/W is SI unit for °C/W.

CHARACTERISTICS

T_{case} = 25 °C

Collector cut-off current				
I_E = 0; V_{CB} = 15 V	I_{CBO}	<	100	nA
I_E = 0; V_{CB} = 30 V	I_{CBO}	<	100	μA
V_{CB} = 25 V; R_{BE} = 220 Ω	I_{CER}	<	500	μA
Emitter cut-off current				
I_C = 0; V_{EB} = 1,5 V	I_{EBO}	<	35	nA
I_C = 0; V_{EB} = 2,0 V	I_{EBO}	<	0.15	μA
DC current gain				
I_C = 25 mA; V_{CE} = 5 V	h_{FE}		20 to 220	
Collector-base capacitance at f = 1 MHz				
I_E = I_C = 0; V_{CB} = 15 V; V_{EB} = 1.5 V	C_{cb}	typ.	0.25	pF
Collector-emitter capacitance at f = 1 MHz				
I_E = I_C = 0; V_{CE} = 15; V_{EB} = 1.5 V	C_{ce}	typ.	0.5	pF
Emitter-base capacitance at f = 1 MHz				
I_E = I_C = 0; V_{EB} = 1.0 V; V_{CB} = 15 V	C_{eb}	typ.	1.3	pF
Forward power gain				
I_C = 25 mA; V_{CE} = 15 V; f = 2 GHz	$\|s_{fe}\|^2$	typ.	9.6	dB
I_C = 25 mA; V_{CE} = 15 V; f = 4 GHz	$\|s_{fe}\|^2$	typ.	3.8	dB
Maximum available gain				
I_C = 25 mA; V_{CE} = 15 V; f = 2 GHz	G_{AM}	typ.	16	dB
I_C = 25 mA; V_{CE} = 15 V; f = 4 GHz	G_{AM}	typ.	10	dB

s-parameters (common emitter)

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

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

The figures given between brackets are values in dB.

APPLICATION INFORMATION

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

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

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

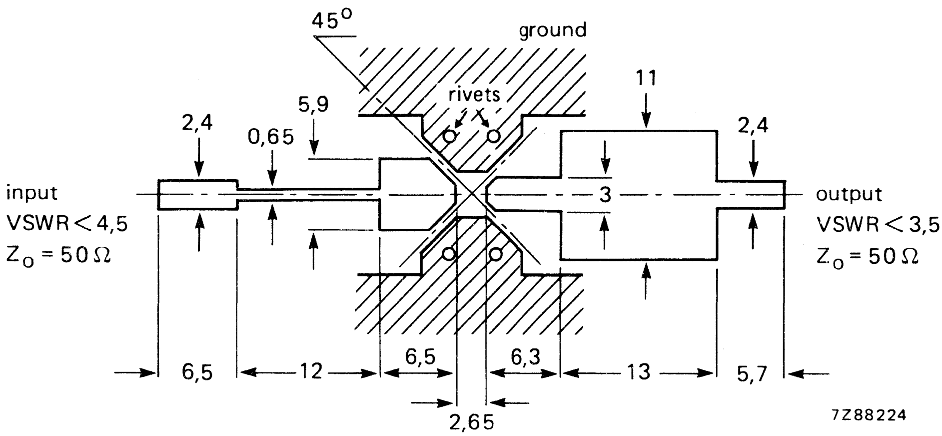


Fig. 4 Prematching test circuit board for 4 GHz. (Dimensions in mm.)

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

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

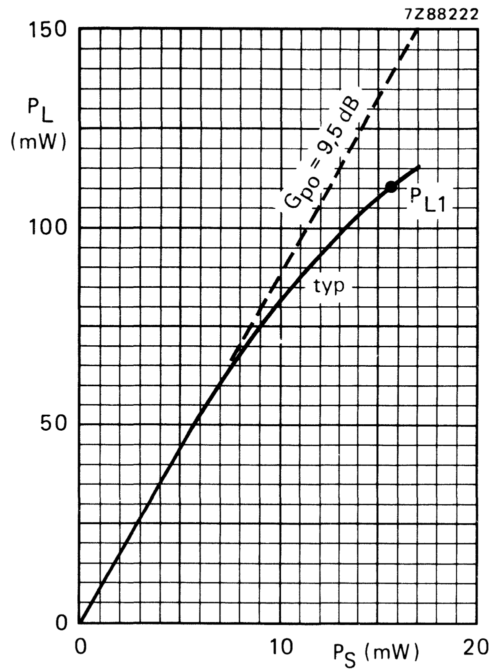


Fig. 5 V_{CE} = 15 V; I_C = 25 mA; f = 4 GHz; T_{case} = 25 °C.

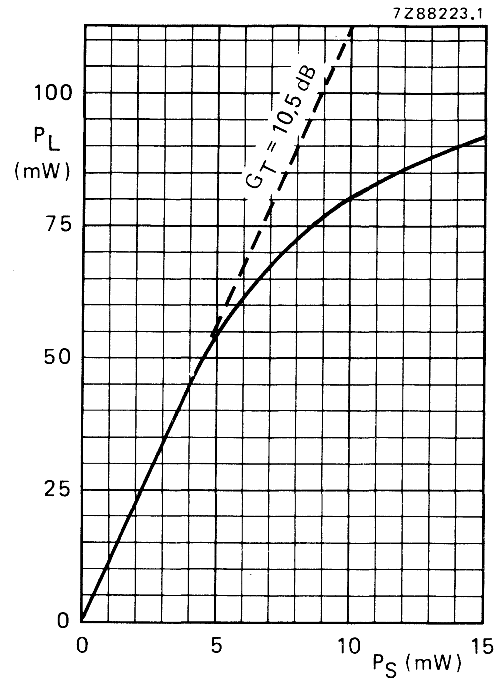


Fig. 6 V_{CE} = 15 V; I_C = 25 mA; f = 4 GHz; maximum low-level linear power gain.

MICROWAVE LINEAR POWER TRANSISTOR

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

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

QUICK REFERENCE DATA

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

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

MECHANICAL DATA

Dimensions in mm

Fig. 1 SOT100.

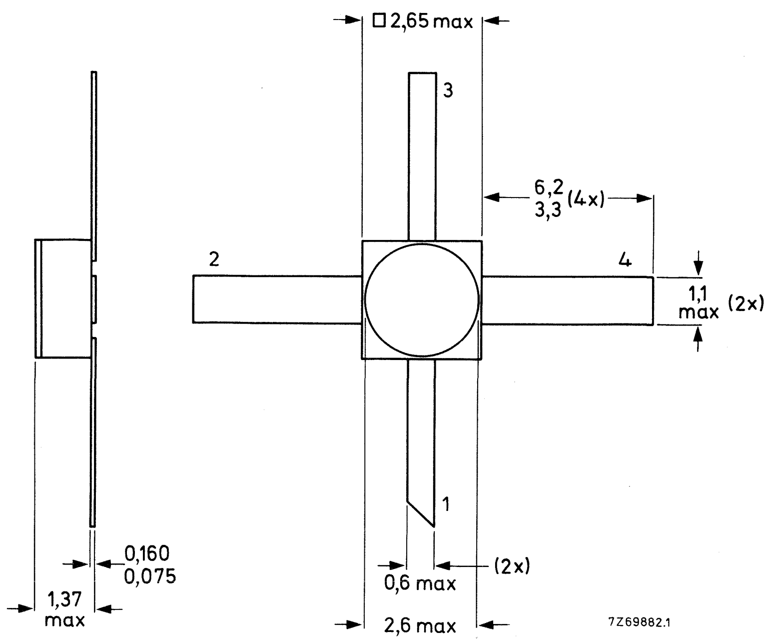
Emitter connected to metallized lid

Marking code:

R9 = LAE4002S

Pinning :

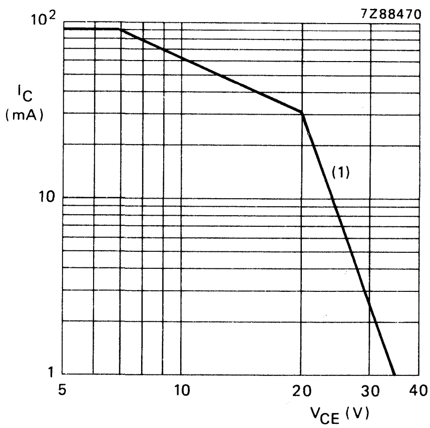
1 = collector
2 = emitter
3 = base
4 = emitter



RATINGS

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

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



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

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

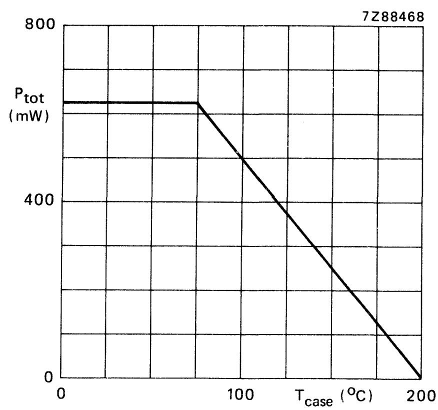


Fig. 3 Power derating curve vs. temperature.

THERMAL RESISTANCE (at T_j = 75 °C)

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

* K/W is SI unit for °C/W.

CHARACTERISTICS

T_{case} = 25 °C

Collector cut-off current			
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	<	100 nA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	<	150 μA
$V_{CB} = 35$ V; $R_{BE} = 220\ \Omega$	I_{CER}	<	500 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	<	50 nA
$I_C = 0$; $V_{EB} = 3.0$ V	I_{EBO}	<	25 μA
DC current gain			
$I_C = 30$ mA; $V_{CE} = 5$ V	h_{FE}		15 to 150
Collector-base capacitance at f = 1 MHz			
$I_E = I_C = 0$; $V_{CB} = 18$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	0.3 pF
Collector-emitter capacitance at f = 1 MHz			
$I_E = I_C = 0$; $V_{CE} = 18$ V; $V_{EB} = 1.5$ V	C_{ce}	typ.	0.55 pF
Emitter-base capacitance at f = 1 MHz			
$I_E = I_C = 0$; $V_{EB} = 1.0$ V; $V_{CB} = 18$ V	C_{eb}	typ.	1.8 pF
Forward power gain			
$I_C = 30$ mA; $V_{CE} = 18$ V; f = 2 GHz	$\lvert s_{fe}\rvert^2$	typ.	8.8 dB
$I_C = 30$ mA; $V_{CE} = 18$ V; f = 4 GHz	$\lvert s_{fe}\rvert^2$	typ.	2.8 dB
Maximum available gain			
$I_C = 30$ mA; $V_{CE} = 18$ V; f = 2 GHz	G_{AM}	typ.	14 dB
$I_C = 30$ mA; $V_{CE} = 18$ V; f = 3 GHz	G_{AM}	typ.	11 dB

s-parameters (common emitter)

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

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

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

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

The figures given between brackets are values in dB.

s-parameters (common emitter)

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

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

The figures given between brackets are values in dB.

APPLICATION INFORMATION

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

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

Notes

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

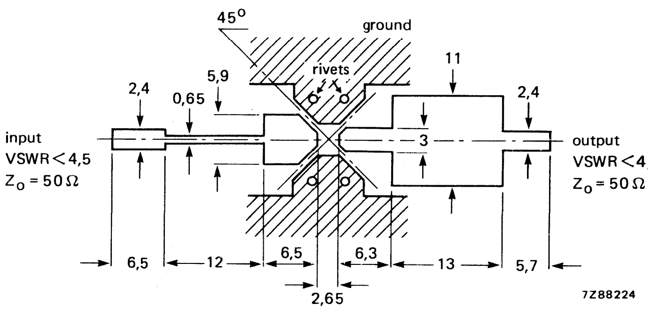


Fig. 4 Prematching test circuit board for 4 GHz. (Dimensions in mm.)

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

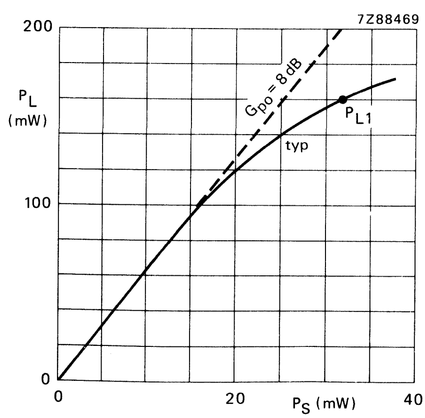


Fig. 5 V_{CE} = 18 V; I_C = 30 mA; f = 4 GHz; T_{case} = 25 °C.

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

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 °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

Dimensions in mm

Fig. 1 SOT100.

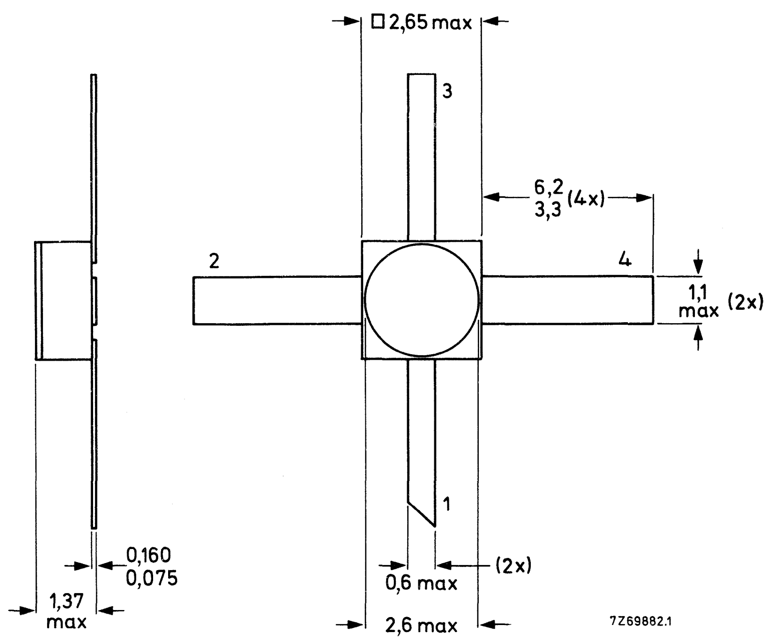
Emitter connected to metallized lid

Marking code:

R7 = LAE6000Q

Pinning :

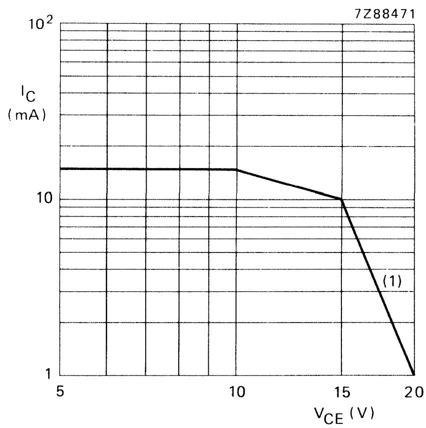
1 = collector
2 = emitter
3 = base
4 = emitter



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 Ω)	V_{CER}	max.	20	V
(open base)	V_{CEO}	max.	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 °C	P_{tot}	max.	150	mW
Storage temperature	T_{stg}	−65 to + 200		°C
Junction temperature	T_j	max.	200	°C
Lead soldering temperature				
at 0.1 mm from the case; $t_{sld} \leqslant$ 10 s	T_{sld}	max.	235	°C



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

Fig. 2 DC SOAR at $T_{case} \leqslant$ 150 °C; $R_{BE} \leqslant$ 150 Ω.

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to case	$R_{th\ j\text{-}c}$	=	300 K/W*

* K/W is SI unit for °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 °C in a common-emitter class-A circuit

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

MECHANICAL DATA

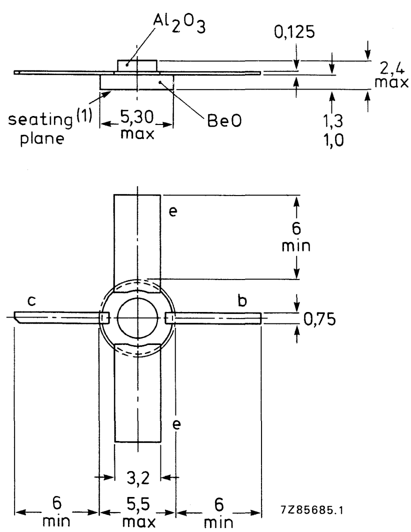
Dimensions in mm

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

FO-45

Marking code:

407 = LBE2003S
409 = LBE2009S



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)

Dimensions in mm

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

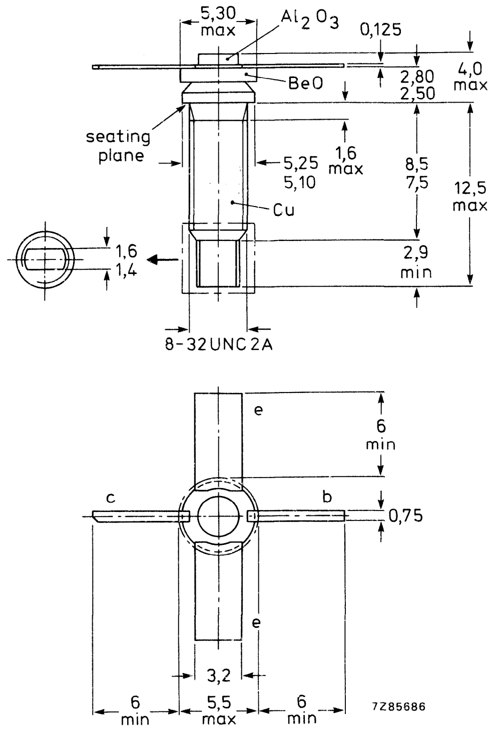
FO-46

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.

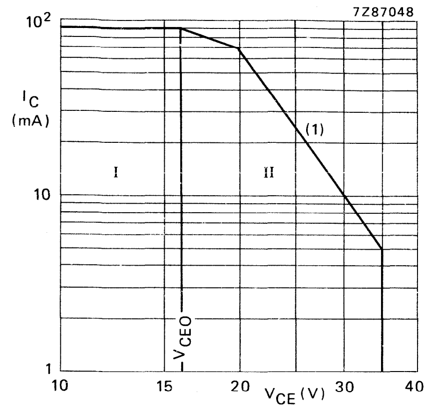


RATINGS

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

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

LBE/LCE2003S



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

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

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

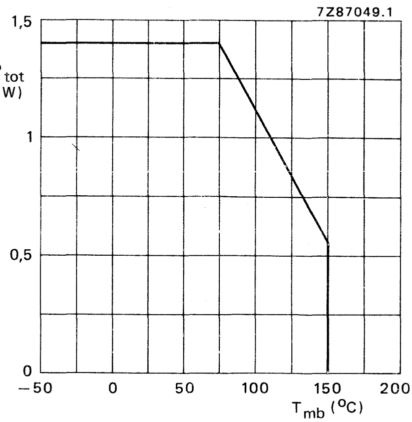
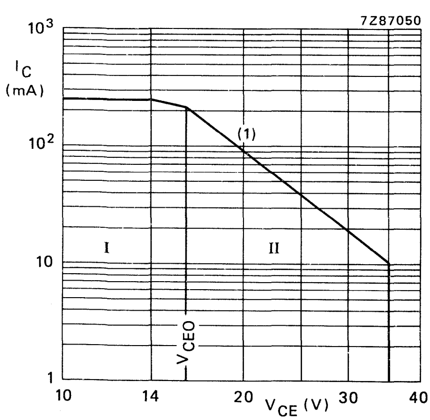


Fig. 3 Power derating curve vs. mounting base temperature.

LBE/LCE2009S



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

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

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

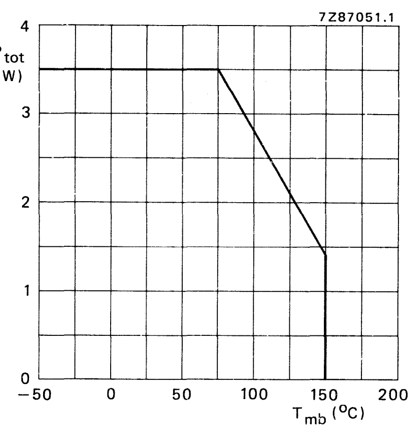


Fig. 5 Power derating curve vs. mounting base temperature.

THERMAL RESISTANCE (at T_j = 75 °C)

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

CHARACTERISTICS

T_{mb} = 25 °C

			LBE/LCE 2003S	LBE/LCE 2009S	
Collector cut-off current					
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	<	0.1	0.1	μA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	<	150	250	μA
$V_{CB} = 35$ V; $R_{BE} = 220\ \Omega$	I_{CER}	<	500	–	μA
$V_{CB} = 35$ V; $R_{BE} = 100\ \Omega$	I_{CER}	<	–	1000	μA
Emitter cut-off current					
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	<	0.05	0.2	μA
$I_C = 0$; $V_{EB} = 3.0$ V	I_{EBO}	<	25	50	μA
DC current gain					
$I_C = 30$ mA; $V_{CE} = 5$ V	h_{FE}	>	15	–	
		<	150	–	
$I_C = 110$ mA; $V_{CE} = 5$ V	h_{FE}	>	–	15	
		<	–	150	
Collector-base capacitance at f = 1 MHz					
$I_E = I_C = 0$; $V_{CB} = 18$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	0.3	0.6	pF
Collector-emitter capacitance at f = 1 MHz					
$I_E = I_C = 0$; $V_{CE} = 18$ V; $V_{EB} = 1.5$ V	C_{ce}	typ.	0.45	0.6	pF
Emitter-base capacitance at f = 1 MHz					
$I_E = I_C = 0$; $V_{EB} = 1$ V; $V_{CB} = 10$ V	C_{eb}	typ.	1.7	3.3	pF

* K/W is SI unit for °C/W.

s-parameters (common emitter)

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

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

The figures given between brackets are values in dB.

* V_{CE} and I_C regulated.

s-parameters (common emitter)

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

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

The figures given between brackets are values in dB.

* V_{CE} and I_C regulated.

APPLICATION INFORMATION

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

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

Notes

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

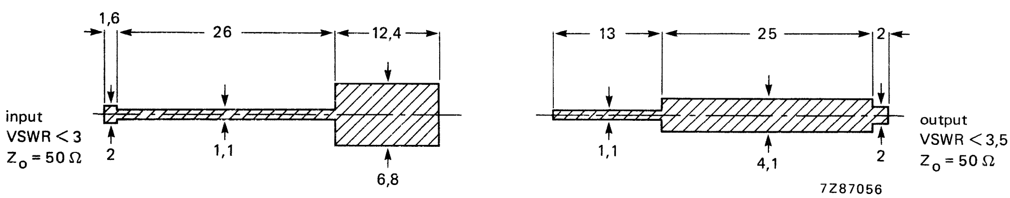


Fig. 6 Prematching test circuit board for 2 GHz. (Dimensions in mm.)

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

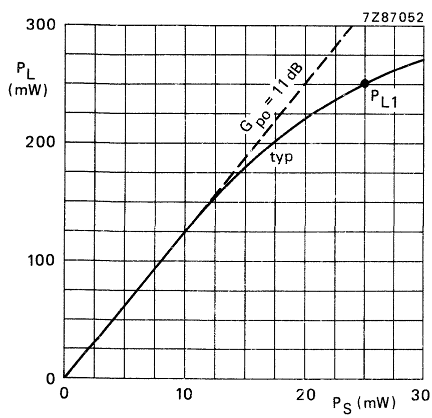


Fig. 7 V_{CE} = 18 V; I_C = 30 mA;
f = 2 GHz; T_{mb} = 25 °C.

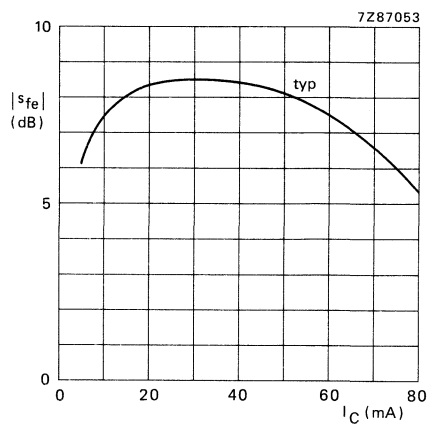


Fig. 8 V_{CE} = 18 V; class-A operation; f = 2 GHz; T_{mb} = 25 °C.

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

APPLICATION INFORMATION

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

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

Notes

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

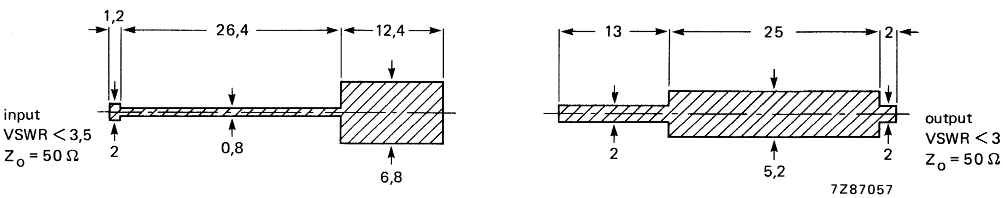


Fig. 9 Prematching test circuit board for 2 GHz. (Dimensions in mm.)

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

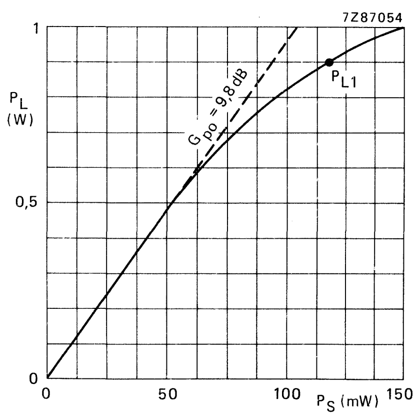


Fig. 10 V_{CE} = 18 V; I_C = 110 mA; f = 2 GHz; T_{mb} = 25 °C.

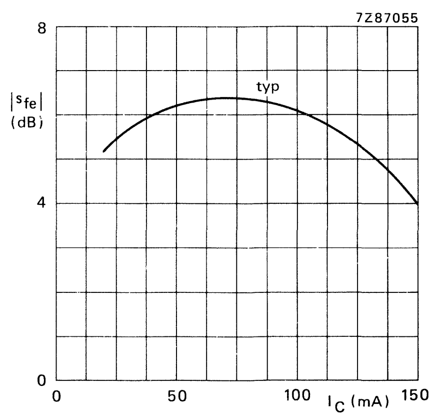


Fig. 11 V_{CE} = 18 V; class-A operation; f = 2 GHz; T_{mb} = 25 °C.

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

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 °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	$\overline{z_i}$ Ω	$\overline{Z_L}$ Ω
c.w.; class-A	4	20	65	200	7	50 + j65	2,5 + j6

MECHANICAL DATA

FO-41A (see Fig. 1).

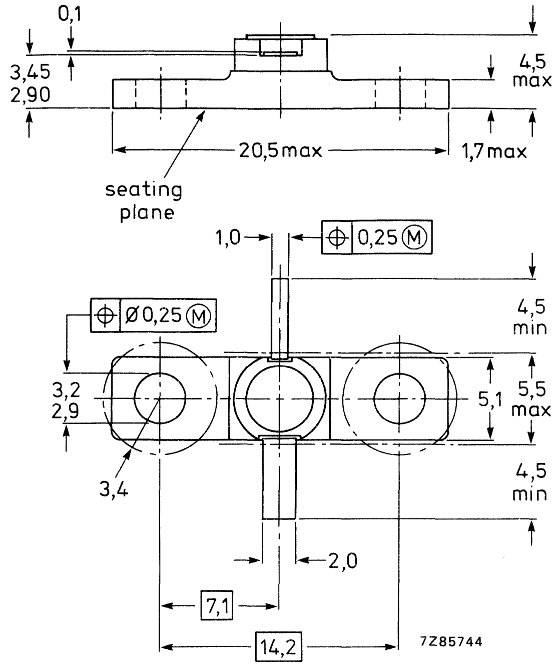
WARNING

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

Dimensions in mm

Fig. 1 FO-41A.



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 Ω)	V_{CER}	max.	25	V
(open base)	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 ($T_{mb} \leq 75\ ^oC$)	P_{tot}	max.	1,5	W
Storage temperature	T_{stg}		−65 to 200	^oC
Junction temperature	T_j	max.	200	^oC
Soldering temperature at 0,1 mm from case; $t_{sld} \leq 10$ s	T_{sld}	max.	235	^oC

THERMAL RESISTANCE

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

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 °C in an unneutralized common-emitter class-A circuit

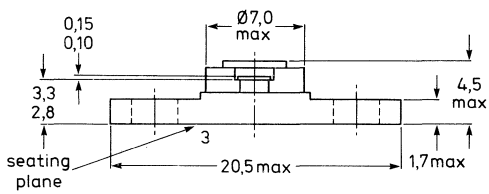
mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} mW	G_{po} dB	z_i Ω	Z_L Ω
CW; linear amplifier	2.1	15	140	typ. 600	typ. 10	6 + j8	4 + j8

MECHANICAL DATA

Dimensions in mm

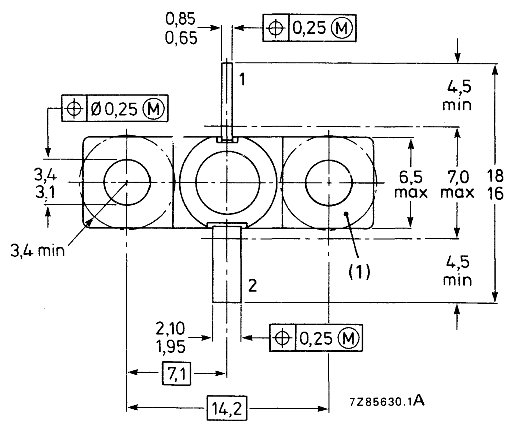
Fig. 1 FO-53.

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				
$R_{be} = 500\ \Omega$	V_{CER}	max.	20	V
open base	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 $T_{mb} = 75\ ^oC$	P_{tot}	max.	2.8	W
Storage temperature	T_{stg}	−65 to + 200		^oC
Junction temperature	T_j	max.	200	^oC
Lead soldering temperature at 0.3 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	^oC

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	22	K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	=	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 °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	2,1	20	300	1750	10	5 + j15	3 − j1

MECHANICAL DATA

FO-53 (see Fig. 1)

WARNING

Product and environmental safety — toxic materials
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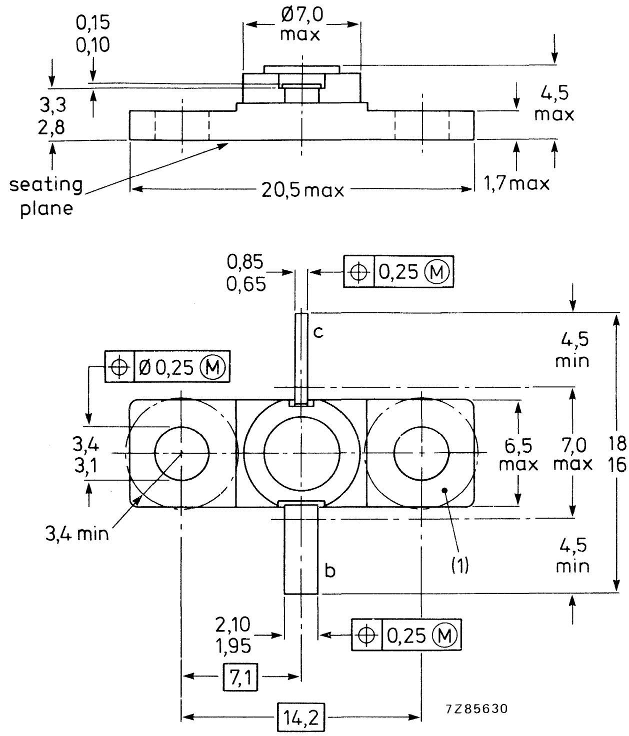
MECHANICAL DATA Dimensions in mm

Fig. 1 FO-53.



RATINGS

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

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

THERMAL RESISTANCE

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

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 °C in an unneutralized 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	2.1	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:

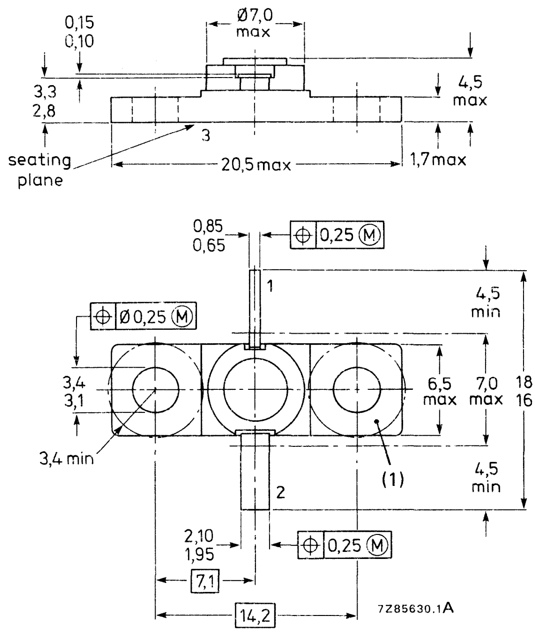
1 = collector
2 = base
3 = emitter

Torque on nut: max. 0.5 Nm

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

THERMAL RESISTANCE (at T_j = 75°C)

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

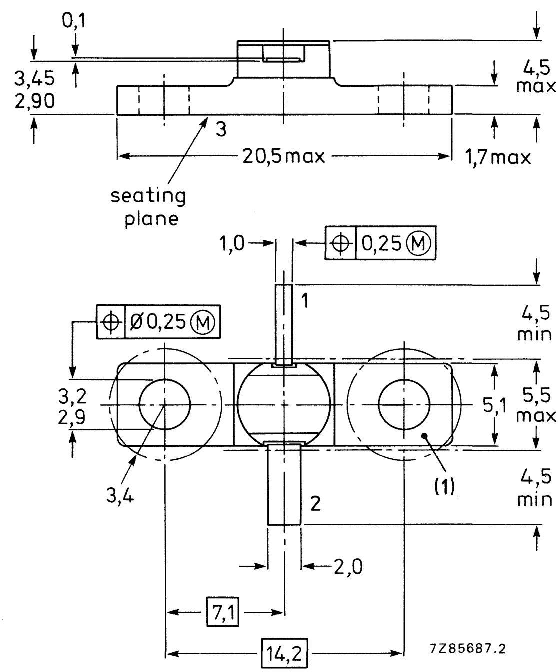
RF performance up to T_{mb} = 25 ^{o}C in an unneutralized common-emitter class-A circuit

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

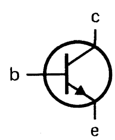
Fig. 1 FO-41B.



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

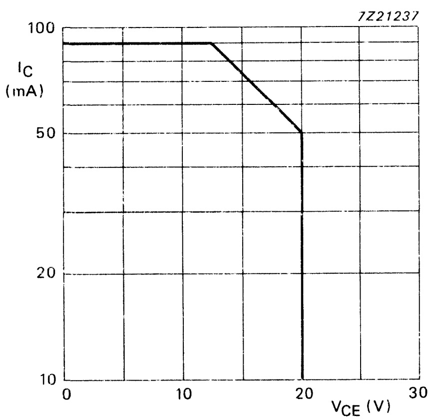


Fig. 2 DC SOAR at $T_{mb} \leqslant$ 75 °C; R_{BE} < 220 Ω.

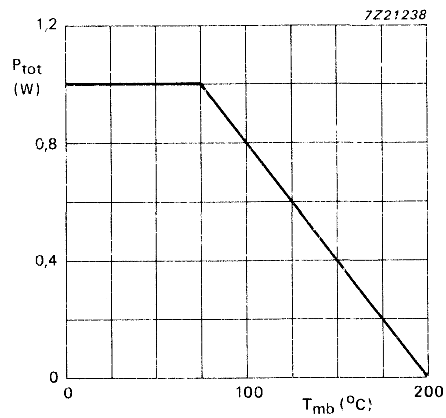


Fig. 3 Power derating curve.

THERMAL RESISTANCE (at Tj=75 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	=	65 K/W

CHARACTERISTICS

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

Collector cut-off currents			
I_E = 0; V_{CB} = 20 V	I_{CBO}	<	100 nA
I_E = 0; V_{CB} = 40 V	I_{CBO}	<	150 μA
V_{BC} = 35 V; R_{BE} = 200 Ω	I_{CER}	<	500 μA
Emitter cut-off currents			
I_C = 0; V_{EB} = 1,5 V	I_{EBO}	<	50 nA
I_C = 0; V_{EB} = 3,0 V	I_{EBO}	<	25 μA
DC current gain			
I_C = 30 mA; V_{CE} = 5 V	h_{FE}		15 to 150

s-parameters (common-emitter)

V_{CE} = 18 V; I_C = 30 mA; T_{mb} = 25 ^oC; Z_O = 50 Ω; typical values

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

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 °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.

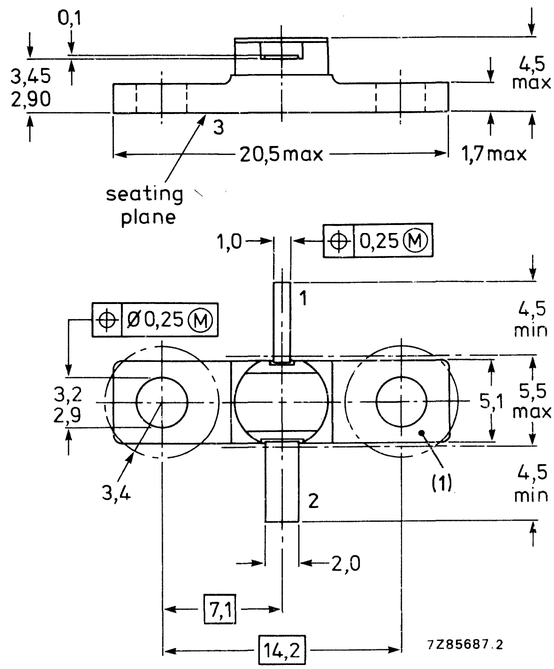
After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general industrial or domestic waste.

MECHANICAL DATA

Dimensions in mm

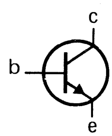
Fig.1 FO-41B.

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

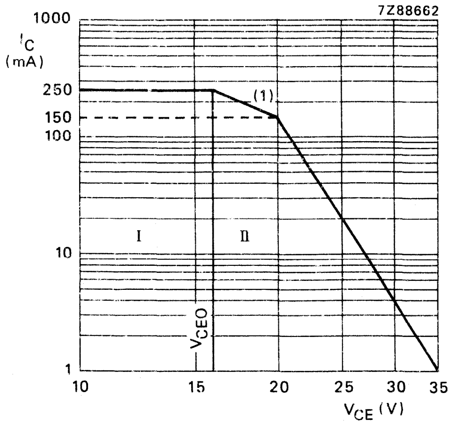
Marking code:
435 = LTE21009R

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



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

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

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

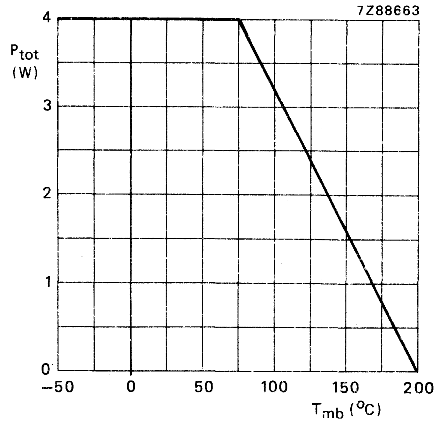


Fig.3 Power derating curve.

THERMAL RESISTANCE (T_{mb} = 25 °C

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	30 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.7 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	max.	50 μA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	max.	0.4 mA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	200 nA
$I_C = 0$; $V_{EB} = 3.5$ V	I_{EBO}	max.	0.1 mA
DC current gain			
$I_C = 150$ mA; $V_{CE} = 5$ V	h_{FE}	min.	15
		max.	150

s-parameters (common emitter)

V_{CE} = 16 V, I_C = 150 mA regulated; T_{mb} = 25 °C; Z_o = 50 Ω; typical values.

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

The figures given between brackets are values in dB.

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 $T_{mb} = 25$ °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

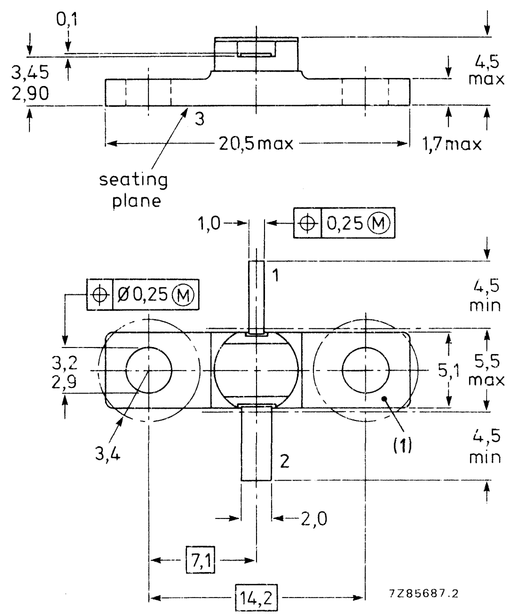
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. **After use,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

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	-	40	V
V_{CER}	collector-emitter voltage	$R_{BE} = 250\ \Omega$	-	20	V
V_{CEO}	collector-emitter voltage	open base	-	16	V
V_{EBO}	emitter-base voltage	open collector	-	3.5	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_{sld}	soldering temperature	$t \leq 10$ s; up to 0.2 mm from ceramic	-	235	°C

THERMAL RESISTANCE

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

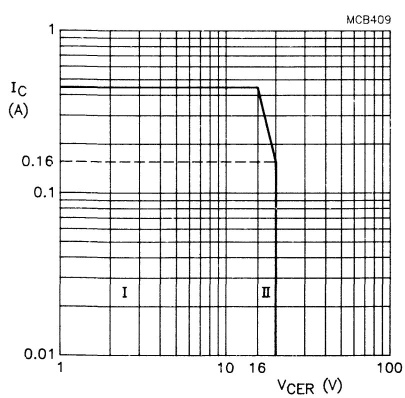


Fig.2 DC SOAR ($T_{mb} = 75$ °C).
I: Region of permissible DC operation
II: Permissible extension provide $R_{BE} < 250\ \Omega$.

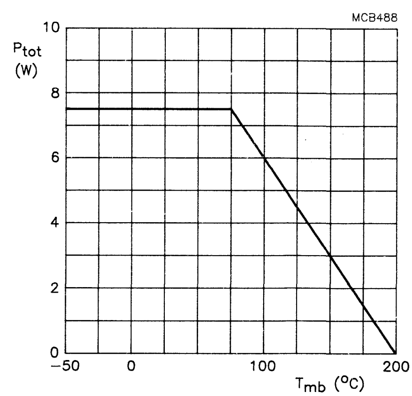


Fig.3 Maximum power dissipation derating as a function of mounting base temperature; P_{tot} max. = 7.5 W.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

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

APPLICATION INFORMATION

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

MODE OF OPERATION	f (GHz)	V_{CC} (V) note 1	I_C (mA) note 1	P_{L1} (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

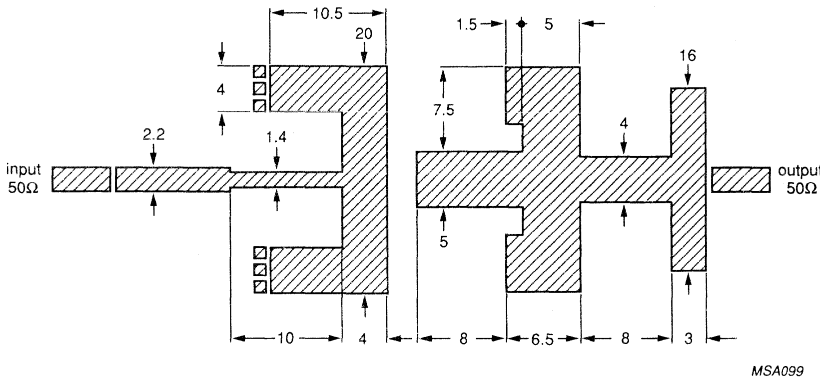
Notes

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
ε = 2.55
thickness= 0.8 mm

Fig.4 Narrowband test circuit

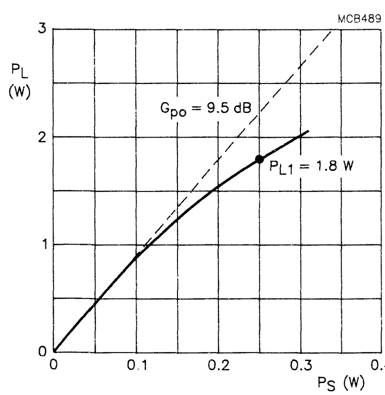


Fig.5 Load power P_L as a function of source power P_S;
V_{CE} = 16 V; I_C = 250 mA (regulated);
(In narrowband test circuit as shown in Fig.4).

NPN silicon planar epitaxial microwave power transistor

LTE21015R

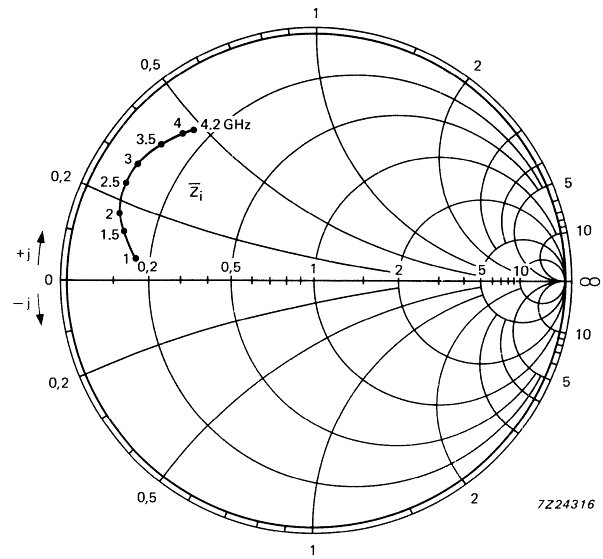


Fig.6 Input impedance as a function of frequency for P_{L1}; associated with optimum load impedance; V_{CE} = 16 V; I_C = 250 mA; Z_o = 50 Ω.

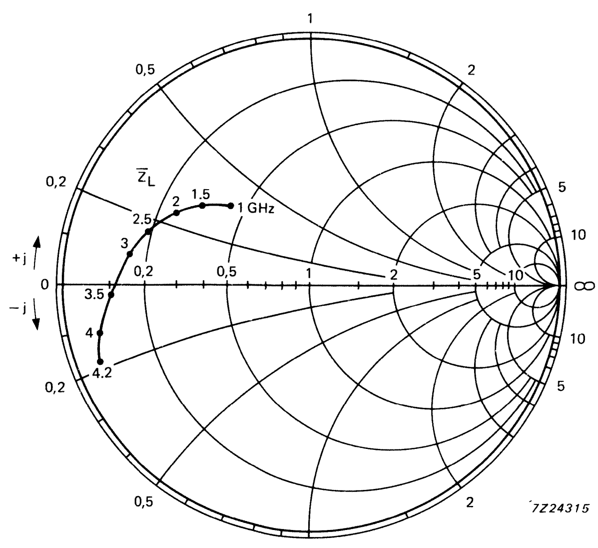


Fig.7 Optimum load impedance as a function of frequency for P_{L1}; associated with input impedance; V_{CE} = 16 V; I_C = 250 mA; Z_o = 50 Ω.

MICROWAVE LINEAR POWER TRANSISTOR

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

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

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

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

QUICK REFERENCE DATA

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

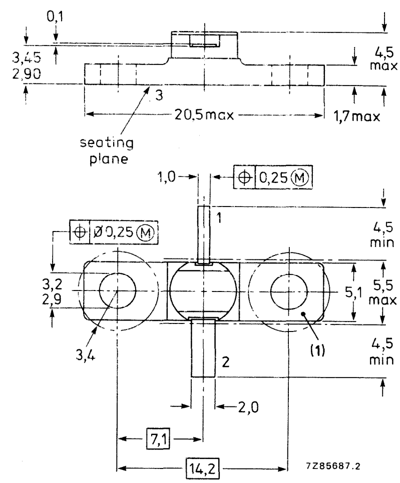
Mode of operation	f GHz	V_{CC} V	I_C mA	P_{L1} W	G_{po} dB
CW class-A	2.1	16	400	typ. 2.8	typ. 7.8

MECHANICAL DATA

Dimensions in mm

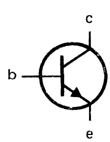
Fig. 1 FO-41B.

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			
$R_{BE} = 70\ \Omega$	V_{CER}	max.	20 V
open base	V_{CEO}	max.	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 $T_{mb} = 75\ ^oC$	P_{tot}	max.	8.0 W
Storage temperature range	T_{stg}		−65 to +200 ^oC
Junction temperature	T_j	max.	200 ^oC
Lead soldering temperature at			
0.3 mm from case; $t_{std} \leqslant 10$ s	T_{sld}	max.	235 ^oC

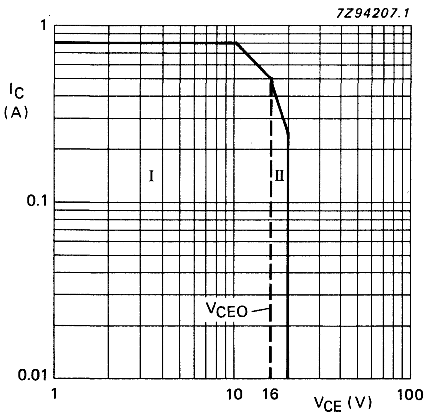


Fig. 2 DC SOAR at $T_{mb} \leqslant 75\ ^oC$.
I Region of permissible DC operation.
II Permissible extention provided $R_{BE} \leqslant 70\ \Omega$.

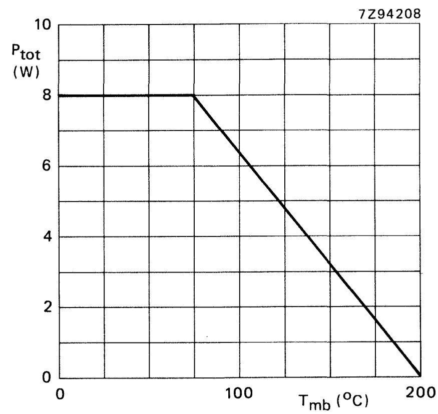


Fig. 3 Power derating curve.

THERMAL RESISTANCE (T_j = 75 °C)

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

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off current				
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	max.	225	μA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	max.	1.5	mA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	600	nA
$I_C = 0$; $V_{EB} = 3.5$ V	I_{EBO}	max.	0.3	mA
DC current gain				
$I_C = 400$ mA; $V_{CE} = 5$ V	h_{FE}	min.	15	
		max.	150	
Collector-base capacitance at f = 1 MHz				
$I_E = I_C = 0$; $V_{CB} = 16$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	3	pF
Collector-emitter capacitance at f = 1 MHz				
$I_C = I_E = 0$; $V_{CE} = 16$ V; $V_{EB} = 1.5$ V	C_{ce}	typ.	1.5	pF
Emitter-base capacitance at f = 1 MHz				
$I_C = I_E = 0$; $V_{EB} = 1$ V; $V_{CB} = 10$ V	C_{eb}	typ.	28	pF

s-parameters (common-emitter)

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

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

The figures between brackets are values in dB.

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 °C in a common-emitter class-A circuit.

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

MECHANICAL DATA

Dimensions in mm

Fig.1 FO-41B.

Emitter and metallic cap are connected to the seating plane.

Pinning

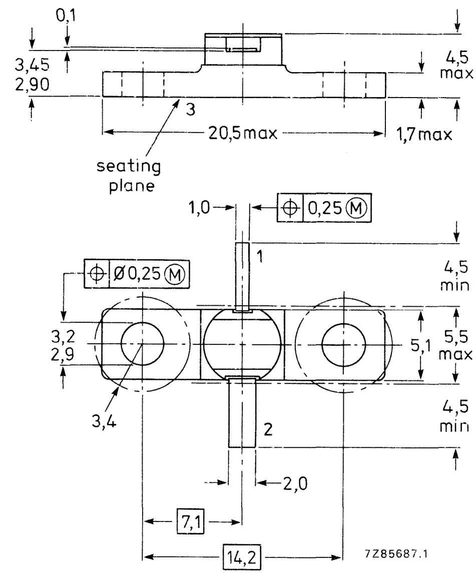
1 = collector
2 = base
3 = emitter

Torque on nut: max. 0.4 Nm

Recommended screw: M2.5

Marking code

502 = LTE42005S



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

WARNING

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

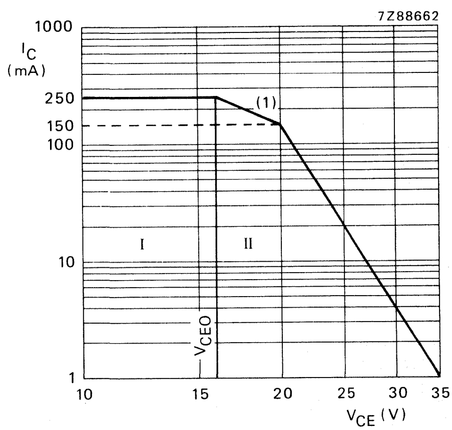
RATINGS

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

THERMAL RESISTANCE (at T_j = 75 °C)

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



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

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

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

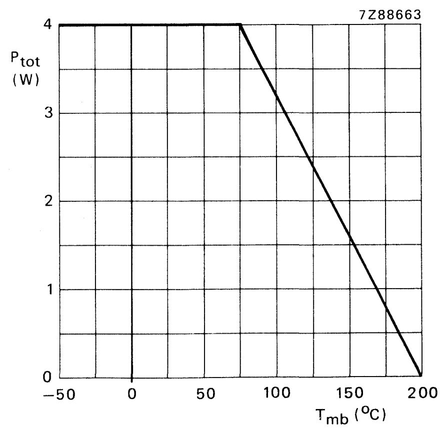


Fig.3 Power derating curve as a function of mounting base temperature.

* K/W is SI unit for °C/W.

CHARACTERISTICS

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

Collector cut-off current				
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	max.	0.1	μA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	max.	0.25	mA
$V_{CE} = 35$ V; $R_{BE} = 100\ \Omega$	I_{CER}	max.	1	mA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	200	nA
$I_C = 0$; $V_{EB} = 3.5$ V	I_{EBO}	max.	50	μA
DC current gain				
$I_C = 110$ mA; $V_{CE} = 5$ V	h_{FE}	min.	15	
		max.	150	
Collector-base capacitance at f = 1 MHz				
$I_E = I_C = 0$; $V_{CB} = 20$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	0.5	pF
Collector-emitter capacitance at f = 1 MHz				
$I_C = I_E = 0$; $V_{CE} = 20$ V; $V_{EB} = 1.5$ V	C_{ce}	typ.	1.5	pF
Emitter-base capacitance at f = 1 MHz				
$I_C = I_E = 0$; $V_{EB} = 1$ V; $V_{CB} = 10$ V	C_{eb}	typ.	6.5	pF

s-parameters (common-emitter)

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

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

The figures given between brackets are values in dB.

APPLICATION INFORMATION

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

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

Notes

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

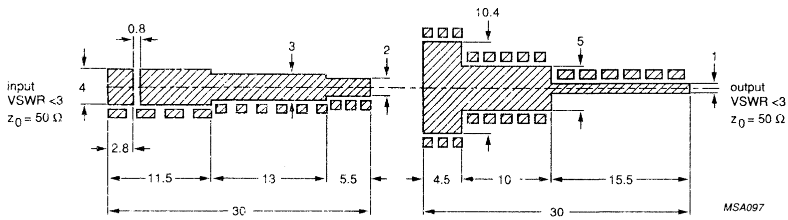


Fig.4 Prematching test circuit board for 4.2 GHz. (Dimensions in mm.)

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

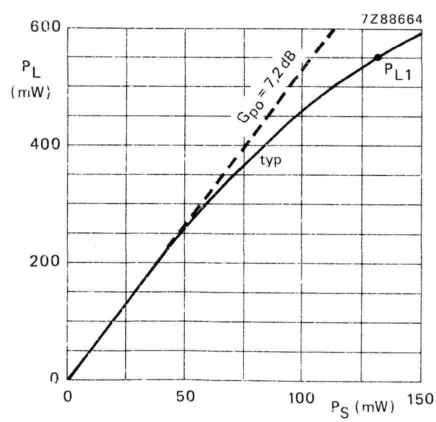


Fig.5 Load power as a function of source power. f = 4.2 GHz; T_{mb} = 25 °C;
V_{CE} = 18 V, I_C = 110 mA } regulated

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

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 °C in a common-emitter class-A circuit.

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

MECHANICAL DATA

Dimensions in mm

Fig.1 FO-41B.

Emitter and metallic cap are connected to the seating plane.

Pinning

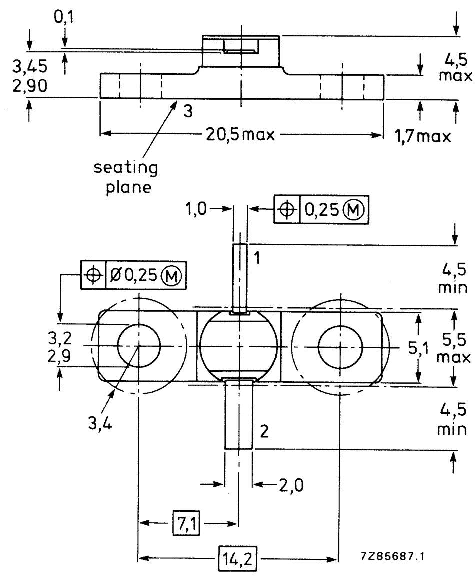
1 = collector
2 = base
3 = emitter

Torque on nut: max. 0.4 Nm

Recommended screw: M2.5

Marking code

196 = LTE42008R



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

WARNING

Product and environmental safety – toxic materials
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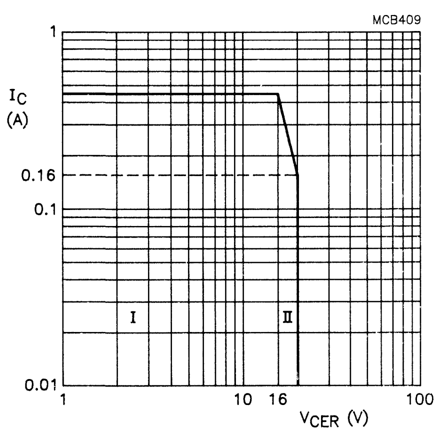
RATINGS

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

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

THERMAL RESISTANCE (at T_j = 70 °C)

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



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

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

I Region of permissible DC operation.

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

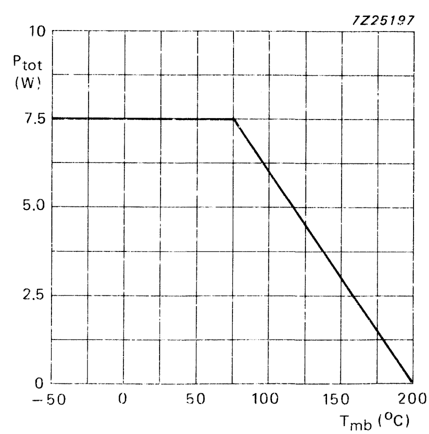


Fig.3 Power derating curve as a function of mounting base temperature.

* K/W is SI unit for °C/W.

CHARACTERISTICS

T_{mb} = 25 °C

Collector cut-off current			
I_E = 0; V_{CB} = 20 V	I_{CBO}	max.	150 μA
I_E = 0; V_{CB} = 40 V	I_{CBO}	max.	1 mA
V_{CE} = 20 V; R_{BE} = 250 Ω	I_{CER}	max.	0.5 mA
Emitter cut-off current			
I_C = 0; V_{EB} = 1.5 V	I_{EBO}	max.	400 nA
I_C = 0; V_{EB} = 3.5 V	I_{EBO}	max.	200 μA
DC current gain			
I_C = 250 mA; V_{CE} = 5 V	h_{FE}	min.	15
		max.	150
Collector-base capacitance at f = 1 MHz			
I_E = I_C = 0; V_{CB} = 16 V; V_{EB} = 1.5 V	C_{cb}	typ.	2 pF
Collector-emitter capacitance at f = 1 MHz			
I_C = I_E = 0; V_{CE} = 16 V; V_{EB} = 1.5 V	C_{ce}	typ.	1.5 pF
Emitter-base capacitance at f = 1 MHz			
I_C = I_E = 0; V_{EB} = 1 V; V_{CB} = 10 V	C_{eb}	typ.	20 pF

s-parameters (common-emitter)

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

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

APPLICATION INFORMATION

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

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

Notes

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

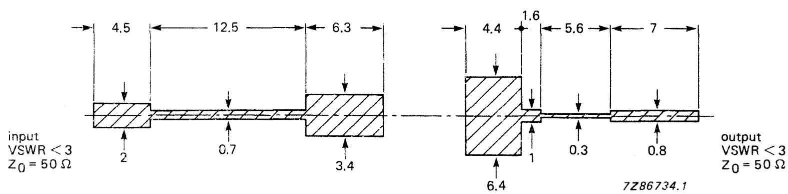


Fig.4 Prematching test circuit board for 4.2 GHz. (Dimensions in mm.)

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

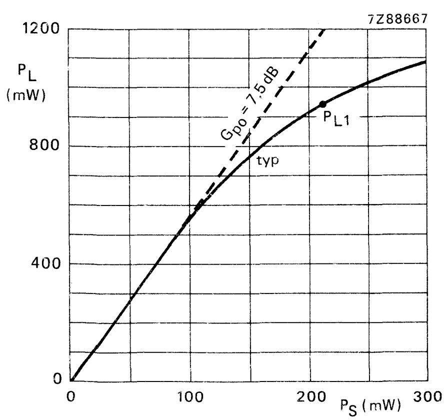


Fig.5 Load power as a function of source power. f = 4.2 GHz; T_{mb} = 25 °C;
V_{CE} = 16 V, I_C = 250 mA } regulated

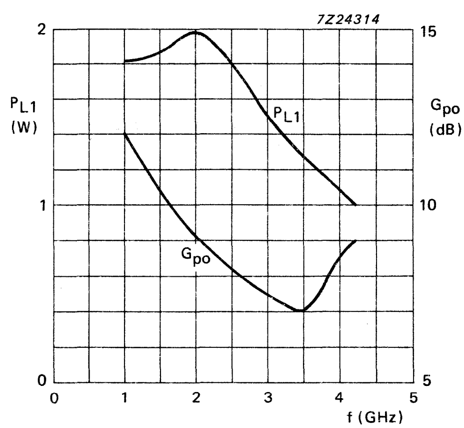


Fig.6 Load power and power gain, associated with 1 dB compressed power gain, as a function of frequency.

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

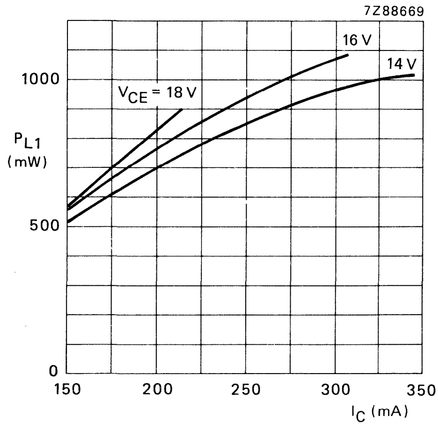


Fig.7 Load power associated with 1 dB compressed power gain, as a function of collector current.

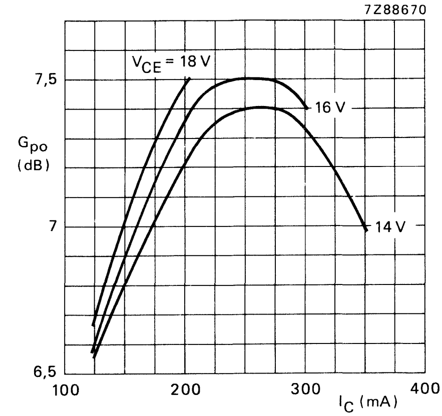


Fig.8 Low-level power gain associated with P_{L1} as a function of collector current.

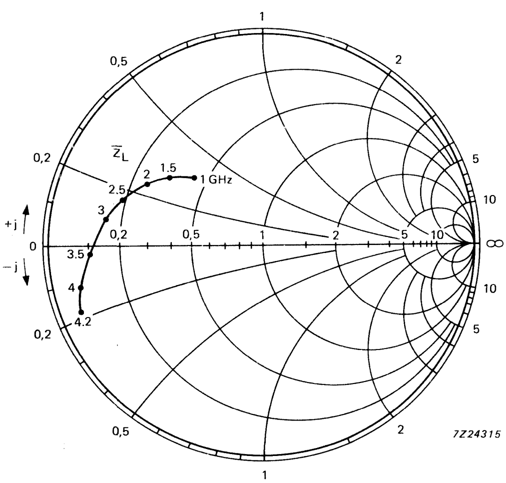


Fig.9 Optimum load impedance as a function of frequency for P_{L1}.

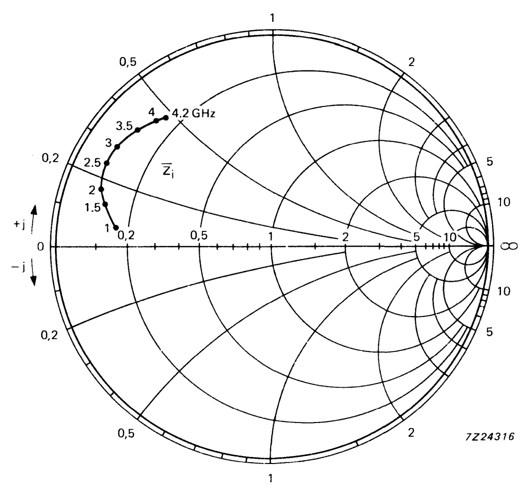


Fig.10 Input impedance as a function of frequency for P_{L1}.

Conditions for Figs 7 and 8:

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

Conditions for Figs 9 and 10:

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

MICROWAVE LINEAR POWER TRANSISTOR

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

Features:

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

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

QUICK REFERENCE DATA

Microwave performance up to T_{mb} = 25 ^{o}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.

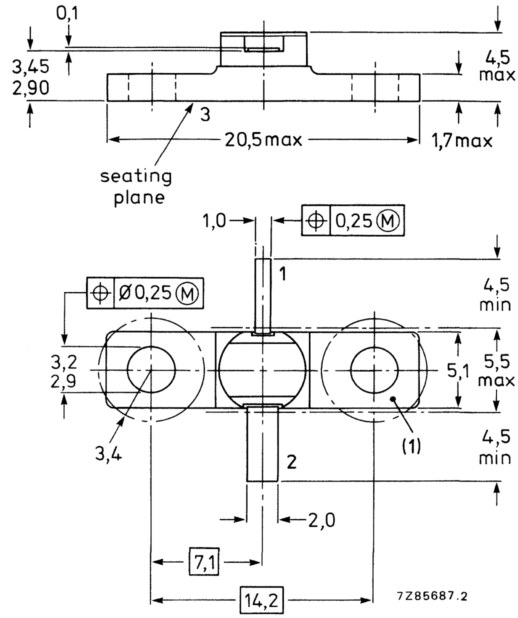
Emitter and metallic cap connected to flange.

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 Ω	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 °C	P_{tot}	max.	8	W
Storage temperature	T_{stg}		−65 to +200	°C
Junction temperature	T_j	max.	200	°C
Soldering temperature at 0.1 mm from ceramic; $t_{sld} \leq 10$ s	T_{sld}	max.	235	°C

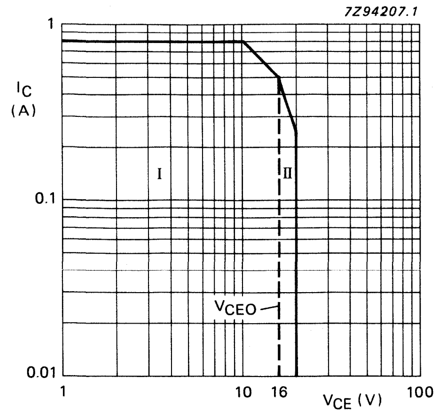


Fig.2 DC SOAR; $T_{mb} \leqslant 75\ ^oC$.
I Region of permissible DC operation.
II Permissible extension provided $R_{BE} \leqslant 70\ \Omega$.

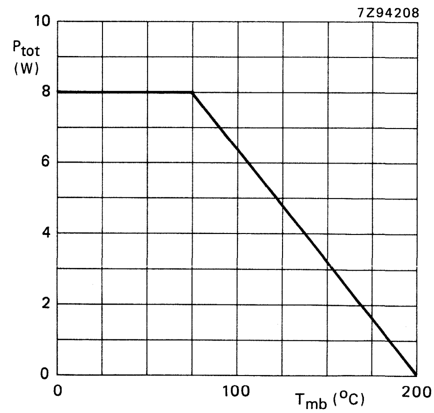


Fig.3 Power derating curve as a function of mounting base temperature.

THERMAL RESISTANCE (at $T_j = 75\ ^oC$

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

CHARACTERISTICS

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

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

s-parameters (common-emitter)

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

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

APPLICATION INFORMATION

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

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

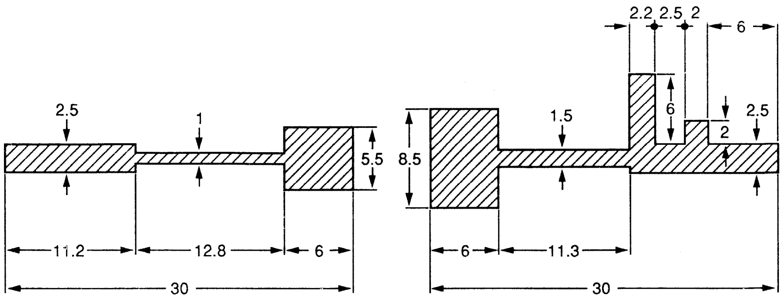


Fig. 4 Prematching test circuit board for CW; class-A application (dimensions in mm).

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

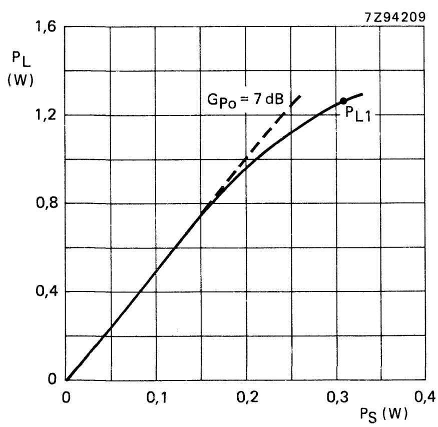


Fig. 5 Load power as a function of input power; f = 4.2 GHz; V_{CE} = 16 V; I_C = 400 mA regulated.

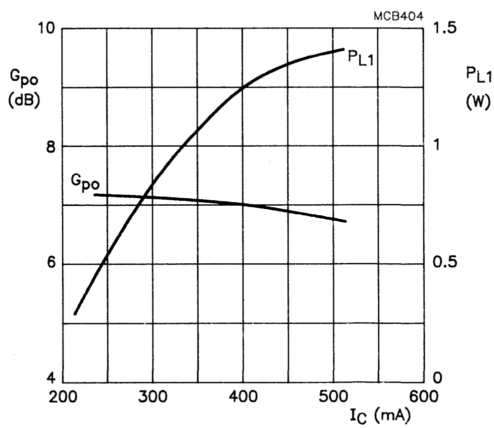


Fig.6 Low level power gain associated with P_{L1} as a function of collector current; f = 4.2 GHZ; V_{CE} = 16 V; I_C = XmA regulated.

* 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 °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

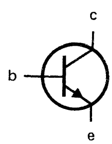
MECHANICAL DATA

Dimensions in mm

Fig.1 FO-163.

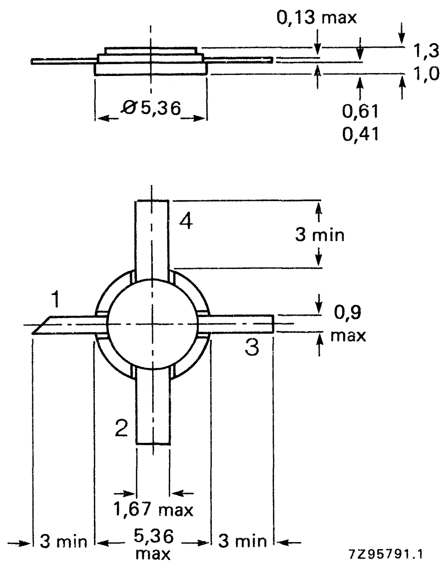
Pinning:

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 Ω	V_{CER}	max.	–	35	V
R_{BE} = 220 Ω	V_{CER}	max.	35	–	V
open base	V_{CEO}	max.	16	16	V
Emitter-base voltage					
open collector	V_{EBO}	max.	3	3	V
Collector current (DC)	I_C	max.	90	250	mA
Total power dissipation					
up to T_{mb} = 75 °C	P_{tot}	max.	1.4	3.5	W
Storage temperature range	T_{stg}		–65 to + 200		°C
Junction temperature	T_j	max.	200		°C
Lead soldering temperature at					
0.3 mm from case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235		°C

LUE2003S

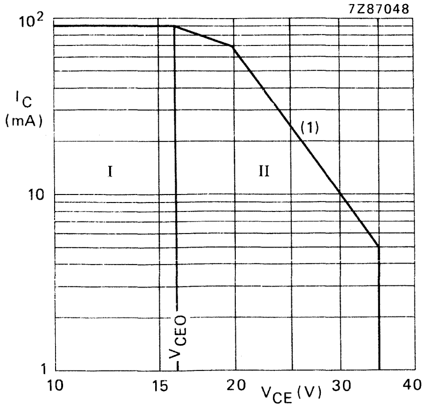


Fig. 2 DC SOAR at $T_{mb} \leqslant 75\ ^oC$.

(1) Second breakdown limit (independent of temperature)

I Region of permissible DC operation.

II Permissible extention provided $R_{BE} \leqslant 220\ \Omega$.

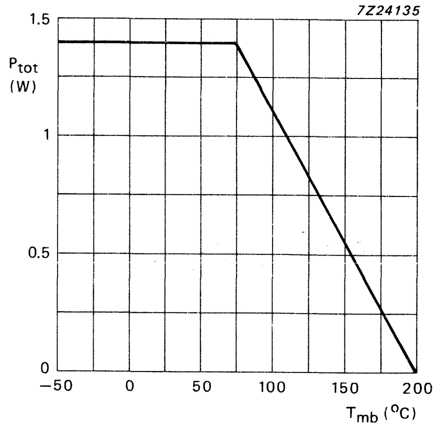


Fig. 3 Power derating curve as a function of base temperature.

LUE2009S

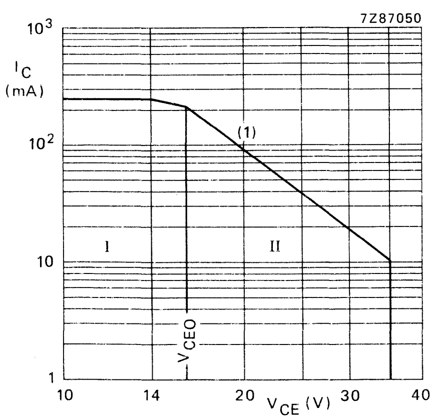


Fig. 4 DC SOAR at $T_{mb} \leqslant 75\ ^oC$.

(1) Second breakdown limit (independent of temperature)

I Region of permissible DC operation.

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

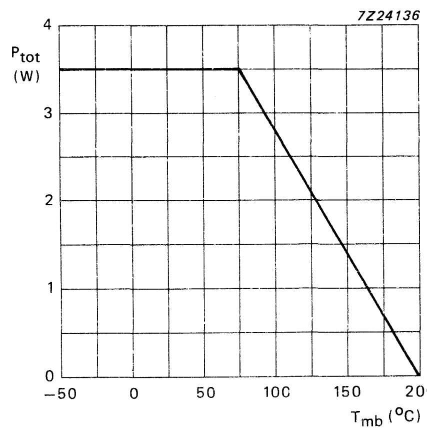


Fig. 5 Power derating curve as a function of base temperature.

THERMAL RESISTANCE (at T_j = 75 °C)

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

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

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

LUE2003S

s-parameters (common-emitter)

V_{CE} = 18 V; I_C = 30 mA; T_{mb} = 25 °C; Z_O = 50 Ω; typical values.

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

LUE2009S

s-parameters (common-emitter)

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

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

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 °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	≥ 7	see Fig. 6	

MECHANICAL DATA

FO-83 (see Fig. 1).

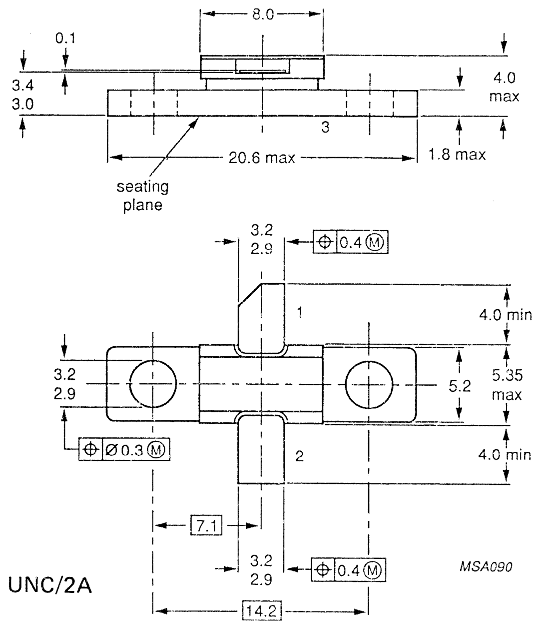
WARNING

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

Dimensions in mm

Fig. 1 FO-83.



Pinning:

1 = collector
2 = base
3 = emitter

Marking code:

1721E50R = LV1721E50R

Torque on screw: max. 0.4 Nm

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

RATINGS

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

Collector-base voltage, open emitter	V_{CBO}	max.	40 V
Collector-emitter voltage			
open base	V_{CEO}	max.	15 V
R_{BE} = 47 Ω	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 °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; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 °C

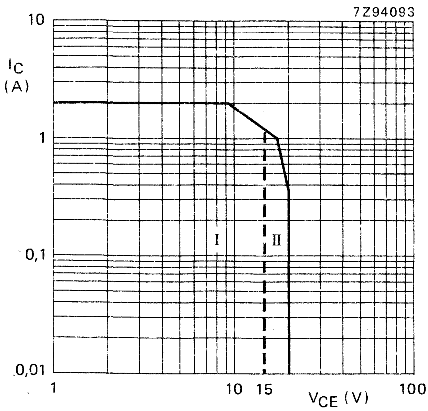


Fig. 2 DC SOAR; $T_{mb} \leq 75\ ^oC$.

I Region of permissible DC operation.

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

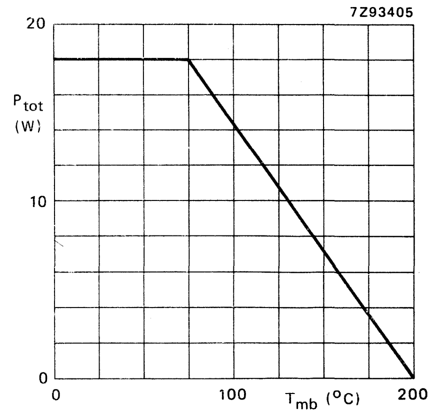


Fig.3 Power derating curve as a function of mounting base temperature.

THERMAL RESISTANCE (at $T_j = 75\ ^oC$)

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

CHARACTERISTICS

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

Collector cut-off currents			
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	max.	0.5 mA
$I_E = 0$; $V_{CB} = 40$ V		max.	2.5 mA
$V_{CE} = 20$ V; $R_{BE} = 47\ \Omega$	I_{CER}	max.	25 mA
$V_{CE} = 15$ V; $I_B = 0$	I_{CEO}	max.	2 mA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	100 μA
$I_C = 0$; $V_{EB} = 3.5$ V		max.	500 μA
DC current gain			
$I_C = 1$ A; $V_{CE} = 3$ V	h_{FE}		15 to 100

APPLICATION INFORMATION

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

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

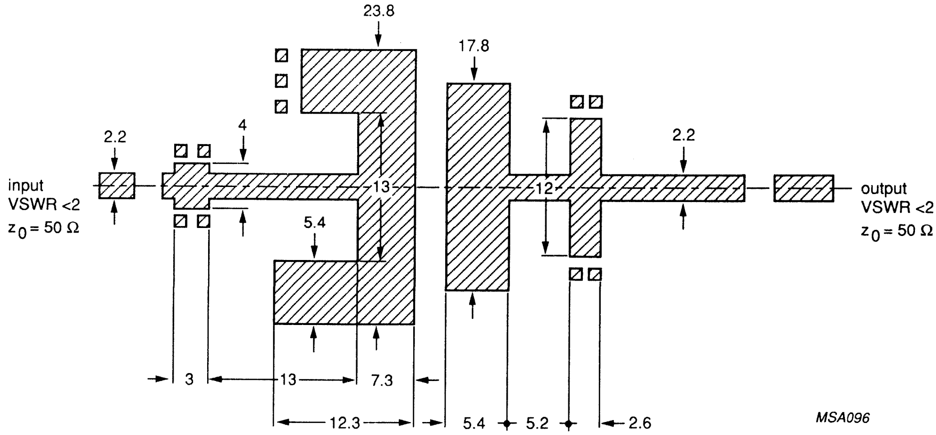


Fig. 4 Wideband test circuit board for 1.7 to 2.1 GHZ, CW, class-A application (Dimensions in mm).

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

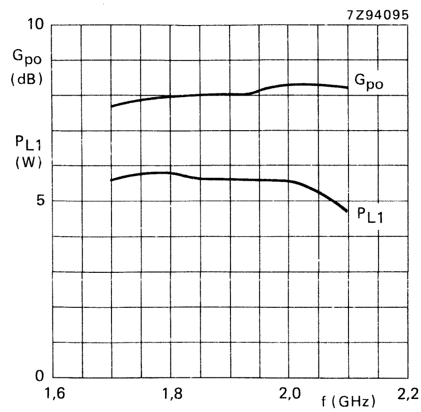


Fig. 5 Load power and power gain as a function of frequency; V_{CE} = 16 V; I_C = 1.1 A; V_{CE} and I_C regulated.

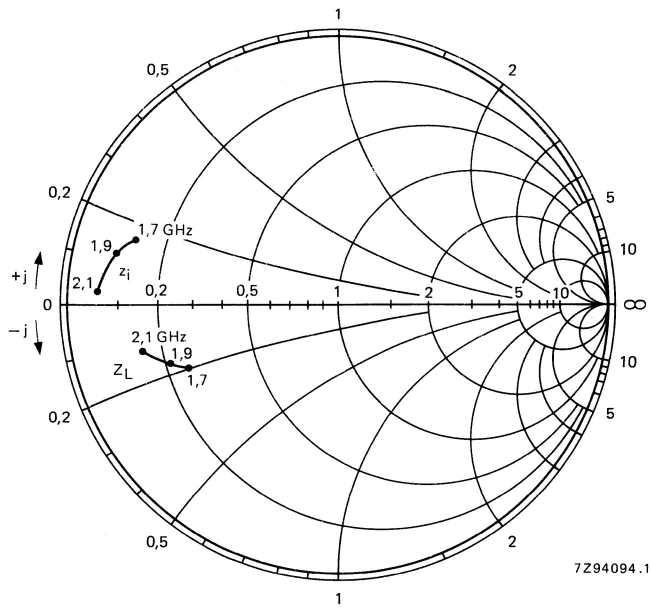


Fig. 6 Input and optimum load impedances as a function of frequency; P_{L1} = 5.5 W; Z_o = 50 Ω; typical values.

MICROWAVE LINEAR POWER TRANSISTOR

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

Features:

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

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

QUICK REFERENCE DATA

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

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

MECHANICAL DATA

FO-83 (see Fig. 1).

WARNING

Product and environmental safety — toxic materials

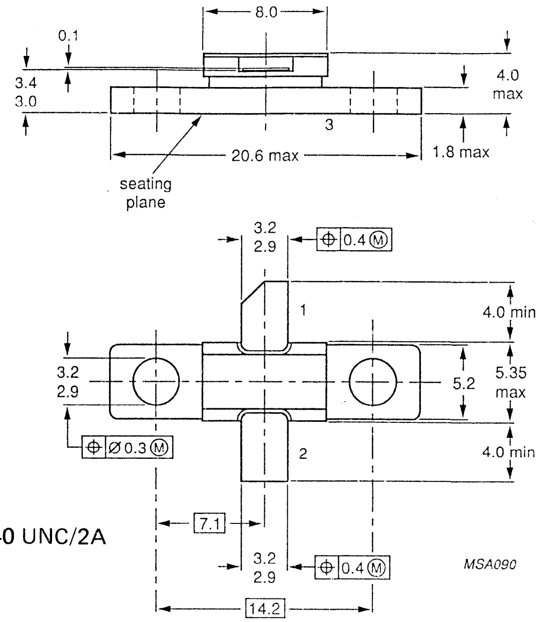
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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				
open base	V_{CEO}	max.	15	V
R_{BE} = 47 Ω	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 °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; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	°C

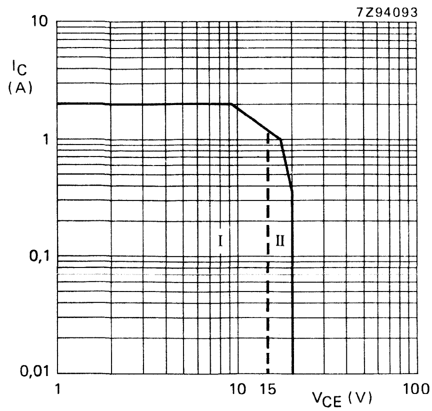


Fig. 2 DC SOAR; $T_{mb} \leqslant 75$ °C.

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

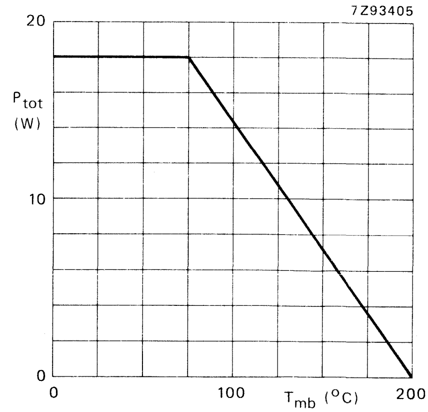


Fig.3 Power derating curve as a function of mounting base temperature.

THERMAL RESISTANCE (at T_j = 75 °C)

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

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off currents		
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	max. 0.5 mA
$I_E = 0$; $V_{CB} = 40$ V		max. 2.5 mA
$V_{CE} = 20$ V; $R_{BE} = 47\ \Omega$	I_{CER}	max. 25 mA
$V_{CE} = 15$ V; $I_B = 0$	I_{CEO}	max. 2 mA
Emitter cut-off current		
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max. 100 µA
$I_C = 0$; $V_{EB} = 3.5$ V		max. 500 µA
DC current gain		
$I_C = 1$ A; $V_{CE} = 3$ V	h_{FE}	15 to 100

APPLICATION INFORMATION

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

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

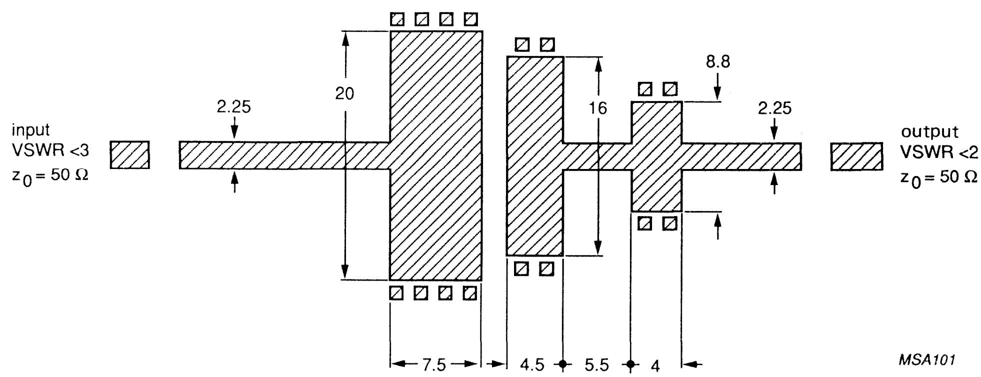


Fig. 4 Wideband test circuit board, class-A application. (Dimensions in mm).

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

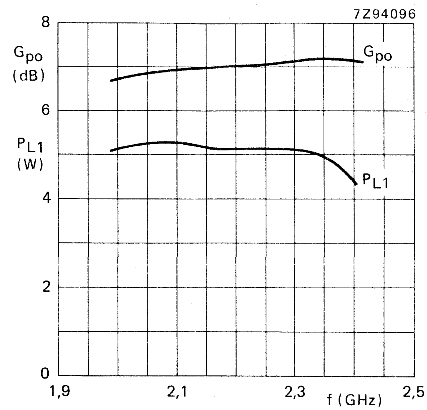


Fig. 5 Load power and power gain as a function of frequency; V_{CE} = 16 V; I_C = 1.1 A; V_{CE} and I_C regulated.

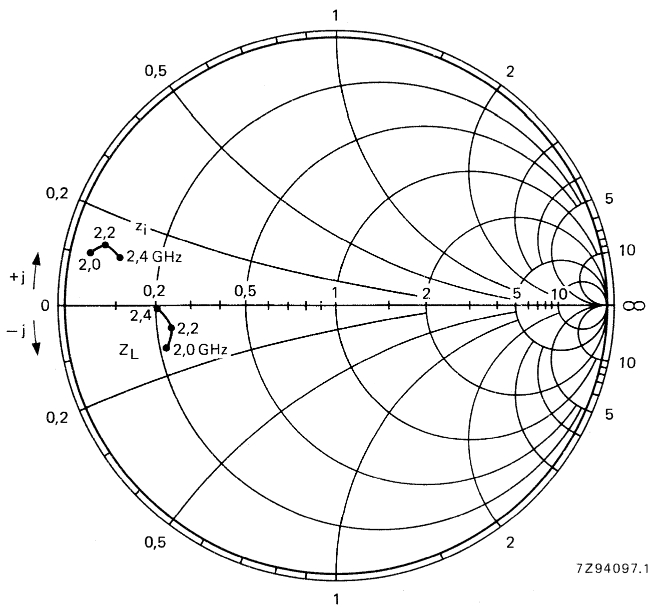


Fig. 6 Input and optimum load impedance as a function of frequency; Z_o = 50 Ω; typical values.

MICROWAVE LINEAR POWER TRANSISTOR

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

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

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

QUICK REFERENCE DATA

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

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

MECHANICAL DATA

FO-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.

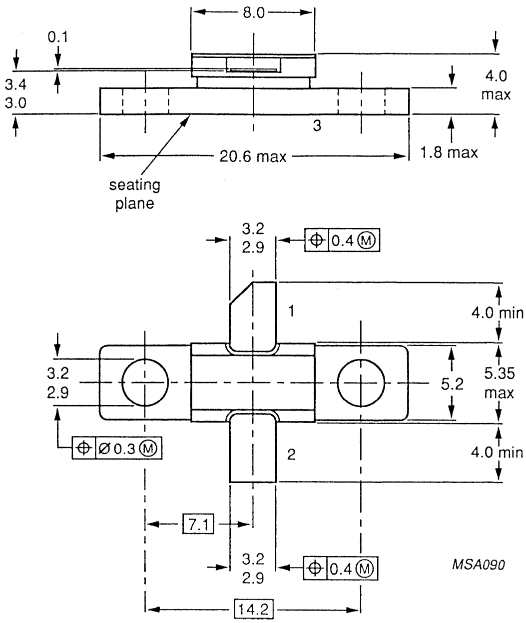
Metallic cap is connected to the flange

→ Torque on screw: max. 0.4 Nm

Recommended screw: M2.5

Marking code:

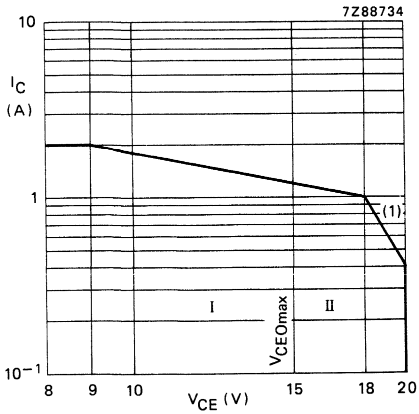
→ 2327E40R = LV2327E40R



RATINGS

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

Collector-base voltage (open emitter)	V_{CBO}	max.	40	V
Collector-emitter voltage				
R_{BE} = 47 Ω	V_{CER}	max.	20	V
open base	V_{CEO}	max.	15	V
Emitter-base voltage (open collector)	V_{EBO}	max.	3.5	V
Collector current (DC)	I_C	max.	2	A
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	18	W
Storage temperature	T_{stg}	−65 to + 200		°C
Junction temperature	T_j	max.	200	°C
Lead soldering temperature at 0.3 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	°C



(1) Second breakdown limit
(independent of temperature)

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

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

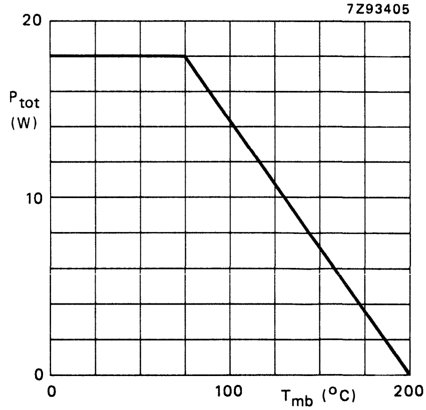


Fig.3 Power derating curve as a function of mounting base temperature.

THERMAL RESISTANCE (at T_j = 75 °C)

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

CHARACTERISTICS

T_{case} = 25 °C unless otherwise specified

Collector cut-off currents			
V_{CB} = 20 V; I_E = 0	I_{CBO}	max.	0.5 mA
V_{CB} = 40 V; I_E = 0	I_{CBO}	max.	2.5 mA
V_{CE} = 20 V; R_{BE} = 47 Ω	I_{CER}	max.	25 mA
V_{CE} = 15 V; I_B = 0	I_{CEO}	max.	2 mA
Emitter cut-off current			
V_{EB} = 1.5 V; I_C = 0	I_{EBO}	max.	100 μA
V_{EB} = 3.5 V; I_C = 0	I_{EBO}	max.	500 μA
DC current gain			
V_{CE} = 3 V; I_C = 1 A	h_{FE}	min.	15
		max.	100

APPLICATION INFORMATION

RF performance in CW operation up to T_{case} = 25 °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	$\overline{z_i}$ Ω	$\overline{Z_L}$ 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}.

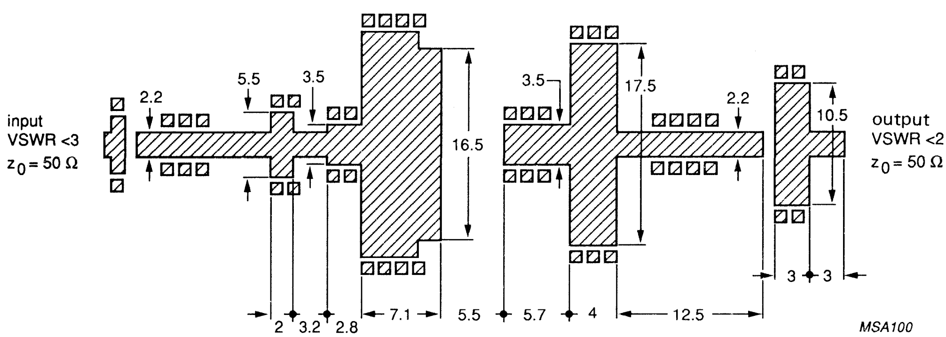


Fig.4 Wideband test circuit board for 2.3 to 2.7 GHz. (Dimensions in mm).

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

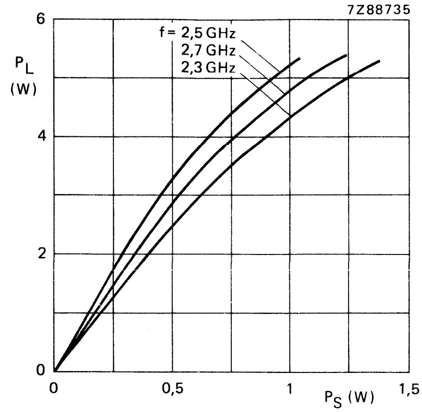


Fig. 5 Load power as a function of source power.

Conditions for Fig. 5:

V_{CE} = 16 V, I_C = 1 A; regulated; typical values; T_{case} = 25 °C.

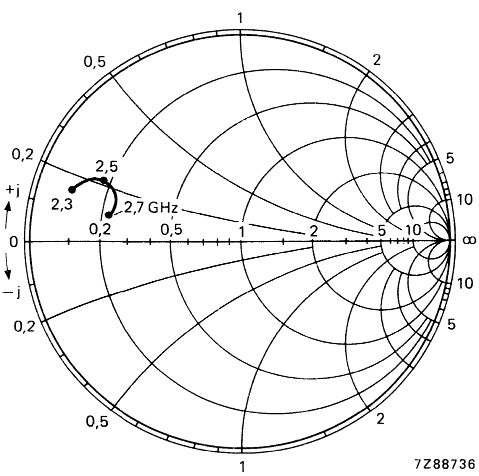


Fig. 6 Input impedance as a function of frequency for P_{L1}.

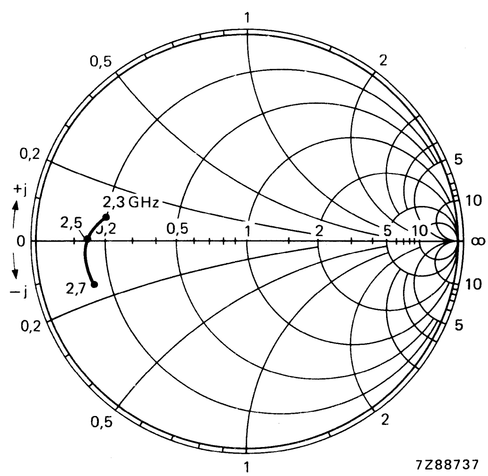


Fig. 7 Optimum load impedance as a function of frequency for P_{L1}.

Conditions for Figs 6 and 7:

V_{CE} = 16 V, I_C = 1 A; regulated; typical values; Z_o = 50 Ω; T_{case} = 25 °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 °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.

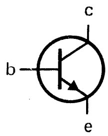
After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general industrial or domestic waste.

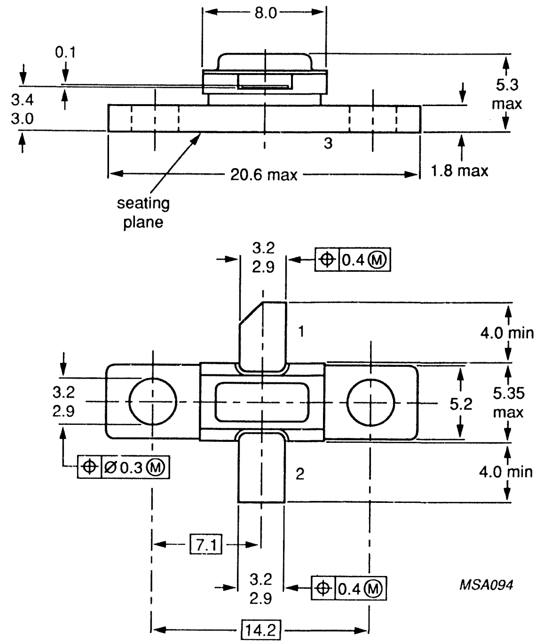
MECHANICAL DATA

Dimensions in mm

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

RATINGS

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

Collector-base voltage, open emitter	V_{CBO}	max.	40 V
Collector-emitter voltage,			
R_{BE} = 100 Ω	V_{CER}	max.	20 V
open base	V_{CEO}	max.	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 °C	P_{tot}	max.	20 W
Storage temperature range	T_{stg}		−65 to +200 °C
Junction temperature	T_j	max.	200 °C
Soldering temperature			
at 0.3 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 °C

THERMAL RESISTANCE (at T_j = 75 °C)

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

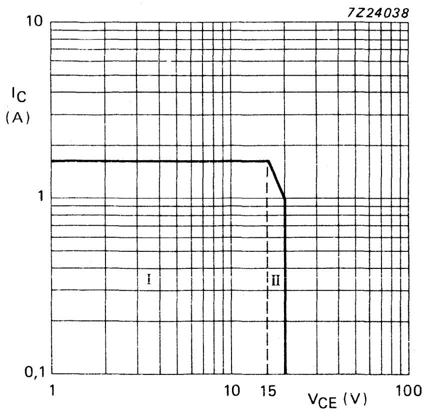


Fig. 2 DC SOAR at T_{mb} = 75 °C

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

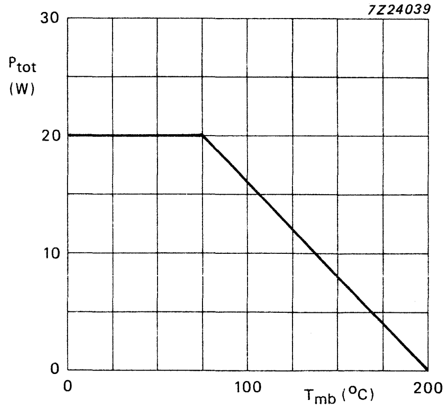


Fig. 3 Power derating curve.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off currents			
V_{CB} = 40 V; I_E = 0	I_{CBO}	max.	6.0 mA
V_{CB} = 30 V; I_E = 0	I_{CBO}	max.	60 μA
V_{CE} = 20 V; R_{BE} = 100 Ω	I_{CER}	max.	100 μA
V_{CE} = 15 V; I_B = 0	I_{CEO}	max.	600 μA
Emitter cut-off currents			
V_{EB} = 1.5 V; I_C = 0	I_{EBO}	max.	6 μA
V_{EB} = 3.5 V; I_C = 0	I_{EBO}	max.	60 μA
DC current gain			
V_{CE} = 5 V; I_C = 1 A	h_{FE}	min.	15
		max.	150

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °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_{po}(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)

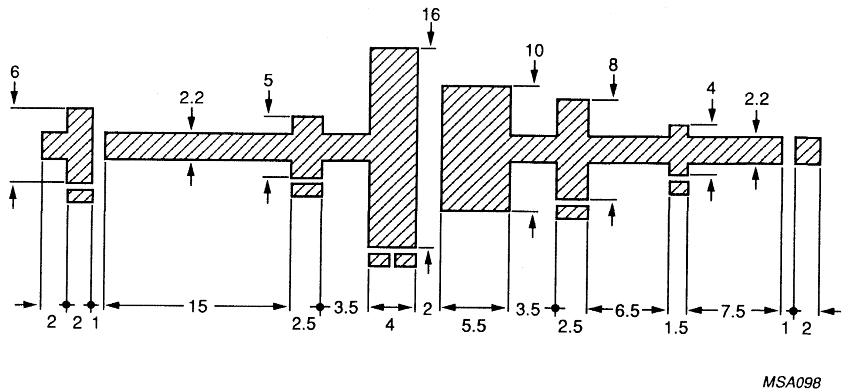


Fig. 4 Broadband test circuit for 2.9 to 3.1 GHz (dimensions in mm). Double Cu clad p.c. board with PTFE fibreglass dielectric, thickness 0.8 mm, $\epsilon_r = 2.54$.

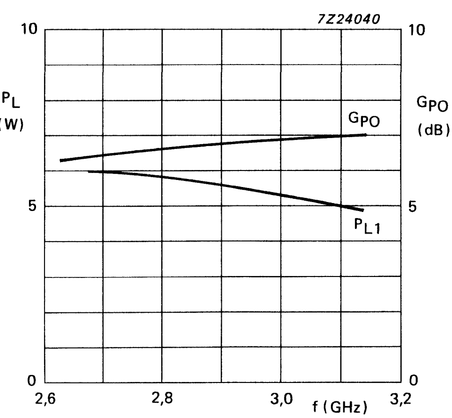


Fig. 5 Load power and power gain as a function of frequency.

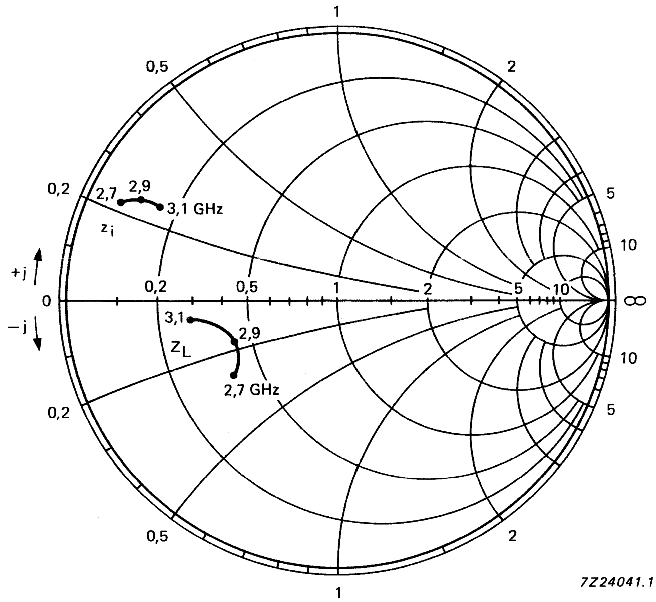


Fig. 6 Input and optimum load impedances as a function of frequency; P_{L1} = 5 W; Z_O = 50 Ω.

MICROWAVE LINEAR POWER TRANSISTOR

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

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

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

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

QUICK REFERENCE DATA

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

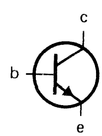
Mode of operation	f GHz	V_{CC} V	I_C A	P_{L1} W	G_{po} dB
CW; class-A	2.1	16	1.1	typ. 5.5	typ. 8.0

MECHANICAL DATA

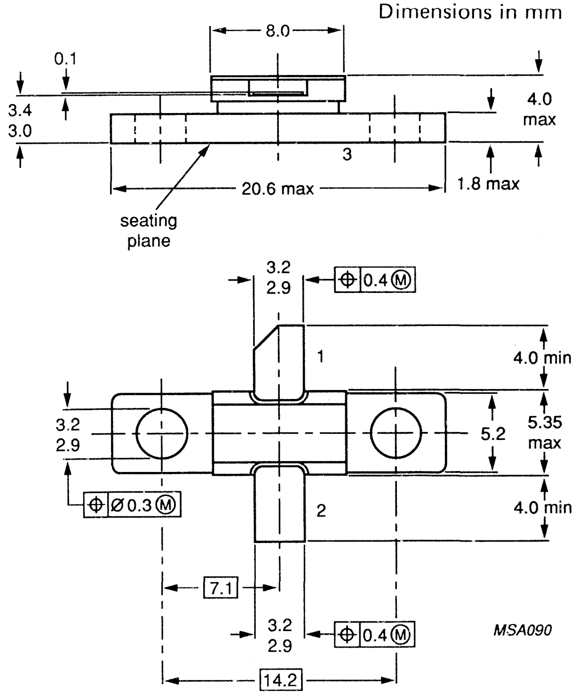
Dimensions in mm

Fig. 1 FO-83.

Pinning
1 = collector
2 = base
3 = emitter



Emitter is connected to the seating plane



Torque on screw: max. 0.4 Nm

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

WARNING

Product and environmental safety — toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO 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 Ω	V_{CER}	max.	20 V
open base	V_{CEO}	max.	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 °C	P_{tot}	max.	18 W
Storage temperature range	T_{stg}	–65 to + 200 °C	
Junction temperature	T_j	max.	200 °C
Lead soldering temperature at			
0,3 mm from case; $t_{sld} \leqslant$ 10 s	T_{sld}	max.	235 °C

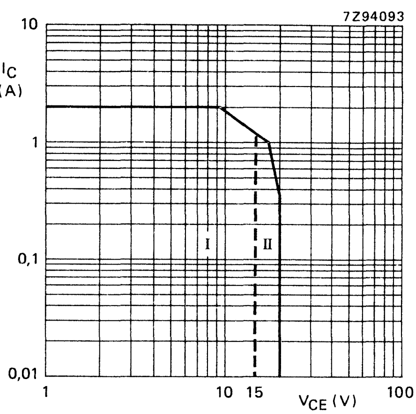


Fig. 2 DC SOAR at $T_{mb} \leqslant$ 75 °C.

I Region of permissible DC operation.

II Permissible extention provided $R_{BE} \leqslant$ 47 Ω.

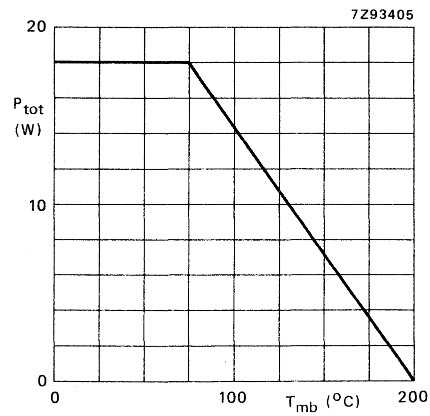


Fig. 3 Power derating curve.

THERMAL RESISTANCE (T_j = 75 °C)

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

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off currents			
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	max.	0.5 mA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	max.	2.5 mA
$V_{CE} = 20$ V; $R_{BE} = 47\ \Omega$	I_{CER}	max.	25 mA
$V_{CE} = 15$ V; $I_B = 0$	I_{CEO}	max.	2 mA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	100 µA
$I_C = 0$; $V_{EB} = 3.5$ V	I_{EBO}	max.	500 µA
DC current gain			
$I_C = 1$ A; $V_{CE} = 3$ V	h_{FE}		15 to 100

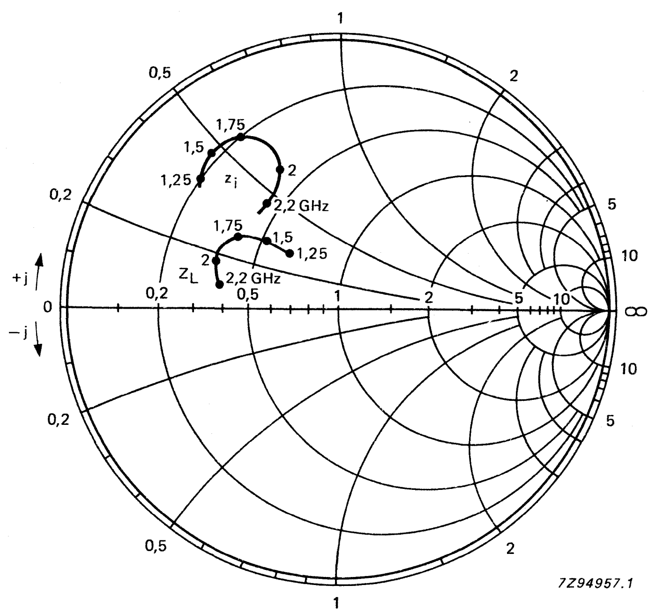


Fig. 4 Input and optimum load impedance as a function of frequency; Z_0 = 10 Ω; typical values.

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 °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

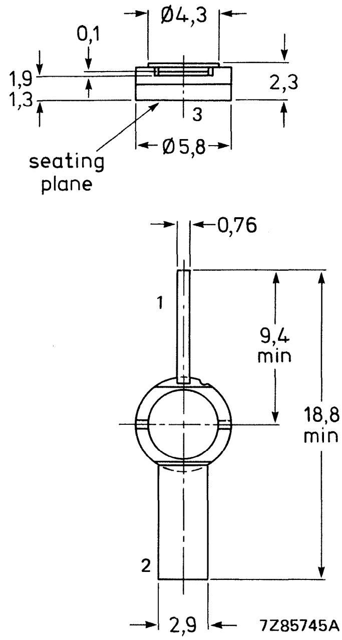
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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 $T_{mb} = 75\ ^oC$	P_{tot}	max.	6 W
Storage temperature	T_{stg}	−65 to + 200	^oC
Junction temperature	T_j	max.	200 ^oC
Soldering temperature at 0.1 mm from case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 ^oC

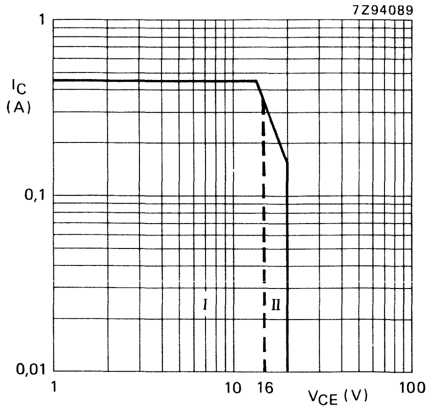


Fig. 2 DC SOAR; $T_{mb} \leqslant 75\ ^oC$.
I Region of permissible DC operation
II Permissible extension at $R_{BE} \leqslant 70\ \Omega$.

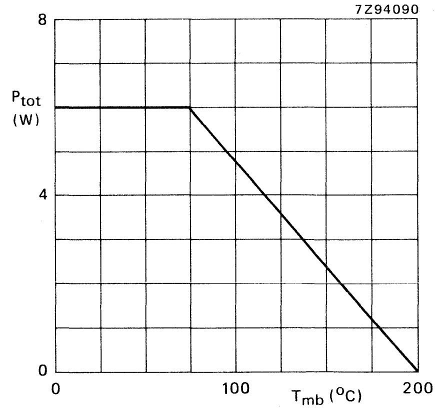


Fig. 3 Power derating curve versus mounting base temperature.

THERMAL RESISTANCE (at Tj=75 ^oC)

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

CHARACTERISTICS

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

Collector cut-off current			
$I_E = 0$; $V_{CB} = 25$ V	I_{CBO}	$\leqslant$	10 μA
$I_E = 0$; $V_{CB} = 35$ V		$\leqslant$	500 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	$\leqslant$	10 μA
$I_C = 0$; $V_{EB} = 3.5$ V		$\leqslant$	100 μA
DC current gain			
$I_C = 230$ mA; $V_{CE} = 5$ V	h_{FE}	typ.	40
Collector-base capacitance at f = 1 MHz			←
$I_E = I_C = 0$; $V_{CB} = 16$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	2 pF
Collector-emitter capacitance at f = 1 MHz			←
$I_E = I_C = 0$; $V_{CE} = 16$ V; $V_{EB} = 1.5$ V	C_{ce}	typ.	2 pF
Emitter-base capacitance at f = 1 MHz			←
$I_E = I_C = 0$; $V_{CB} = 10$ V; $V_{EB} = 1$ V	C_{eb}	typ.	15 pF

APPLICATION INFORMATION

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

mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} W	G_{po} dB	z_i Ω	Z_L Ω
CW; class-A	2.3	16	250	⩾ 1.2 typ. 1.6	⩾ 7.5 typ. 8.1	3.5 + j11	6.4 + j2

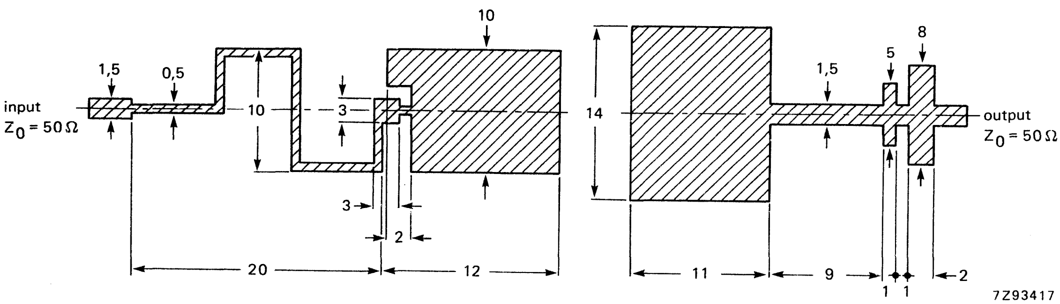


Fig. 4 Prematching test circuit board with PTFE fibre-glass dielectric (ϵ_r = 2.54), thickness 0.8 mm.

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

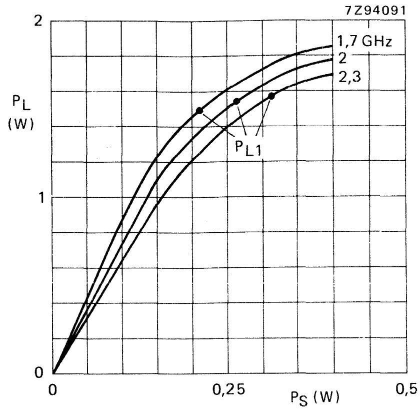


Fig. 5 Output power versus source power.

Conditions for Figs 5 and 6:

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

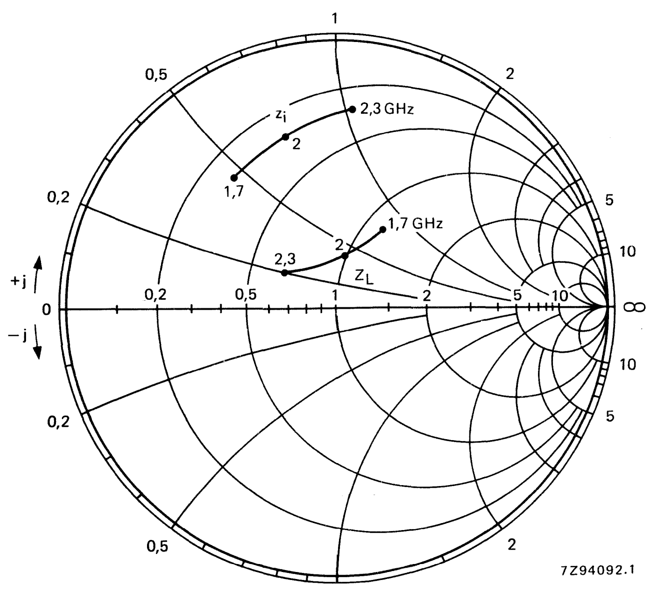


Fig. 6 Input and optimum load impedances versus frequency; Z_o = 10 Ω; P_{L1} = 1.6 W; T_{mb} = 25 °C.

MICROWAVE LINEAR POWER TRANSISTOR

NPN silicon power transistor for use in a common-emitter, class-A amplifier up to 2.3 GHz in CW conditions in military and professional applications.

Features:

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistor providing excellent current sharing and withstanding a high VSWR
- Gold metallization realizing a very good stability of the characteristics and excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- 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 °C in an unneutralized common-emitter class-A selective amplifier

mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} W	G_{po} dB	z_i Ω	Z_L Ω
CW; class-A	2.3	16	400	⩾ 2	⩾ 7	2 + j8	5.5 − j1.8

MECHANICAL DATA

Dimensions in mm

FO-93 (see Fig. 1).

WARNING

Product and environmental safety — toxic materials

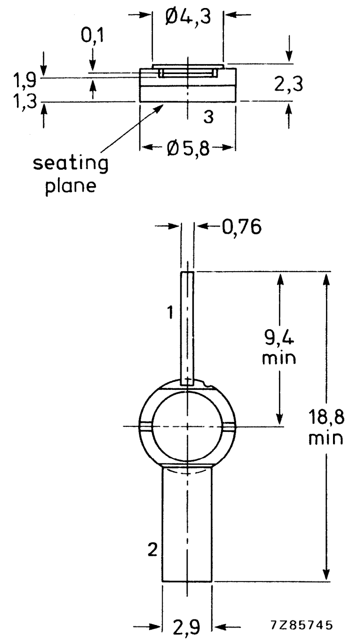
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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

MECHANICAL DATA

Dimensions in mm

Fig. 1 FO-93.



Marking code
413 = LWE2025R

Pinning:

1 = collector
2 = base
3 = emitter

RATINGS

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

Collector-base voltage, open emitter	V_{CBO}	max.	35	V
Collector-emitter voltage				
open base	V_{CEO}	max.	16	V
R_{BE} = 70 Ω	V_{CER}	max.	20	V
Emitter-base voltage, open collector	V_{EBO}	max.	3.5	V
Collector current (DC)	I_C	max.	800	mA
Total power dissipation				
up to T_{mb} = 75 °C	P_{tot}	max.	8	W
Storage temperature	T_{stg}	−65 to + 200		°C
Junction temperature	T_j	max.	200	°C
Soldering temperature				
at 0.1 mm from case; $t_{sld} \leqslant$ 10 s	T_{sld}	max.	235	°C

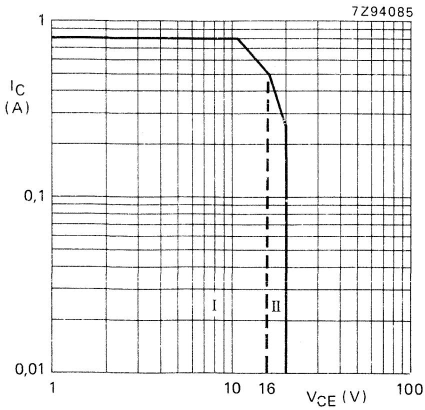


Fig. 2 DC SOAR; $T_{mb} \leqslant 75\ ^oC$.

I Region of permissible DC operation

II Permissible extension provided $R_{BE} \leqslant 70\ \Omega$.

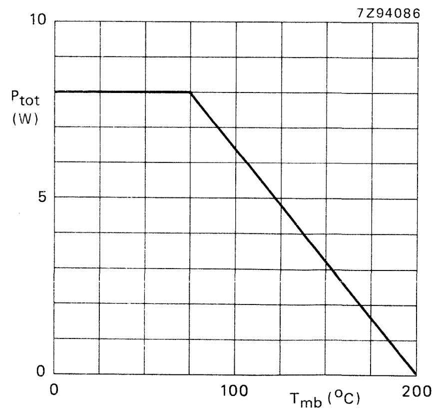


Fig. 3 Power derating curve versus mounting base temperature.

THERMAL RESISTANCE (at Tj=75 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	8 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off current			
$I_E = 0$; $V_{CB} = 25$ V	I_{CBO}	$\leqslant$	15 μA
$I_E = 0$; $V_{CB} = 35$ V		$\leqslant$	700 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	$\leqslant$	15 μA
$I_C = 0$; $V_{EB} = 3.5$ V		$\leqslant$	150 μA
DC current gain			
$I_C = 400$ mA; $V_{CE} = 5$ V	h_{FE}	typ.	40
Collector-base capacitance at f = 1 MHz			
$I_E = I_C = 0$; $V_{CB} = 16$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	3 pF
Collector-emitter capacitance at f = 1 MHz			
$I_E = I_C = 0$; $V_{CE} = 16$ V; $V_{EB} = 1.5$ V	C_{ce}	typ.	2.2 pF
Emitter-base capacitance at f = 1 MHz			
$I_E = I_C = 0$; $V_{CB} = 10$ V; $V_{EB} = 1$ V	C_{eb}	typ.	83 pF

APPLICATION INFORMATION

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

mode of operation	f GHz	V_{CE} V	I_C mA	P_{L1} W	G_{po} dB	z_i Ω	Z_L Ω
CW; class-A	2.3	16	400	⩾ 2 typ. 2.8	⩾ 7 typ. 7.8	2 + j8	5.5 − j1.8

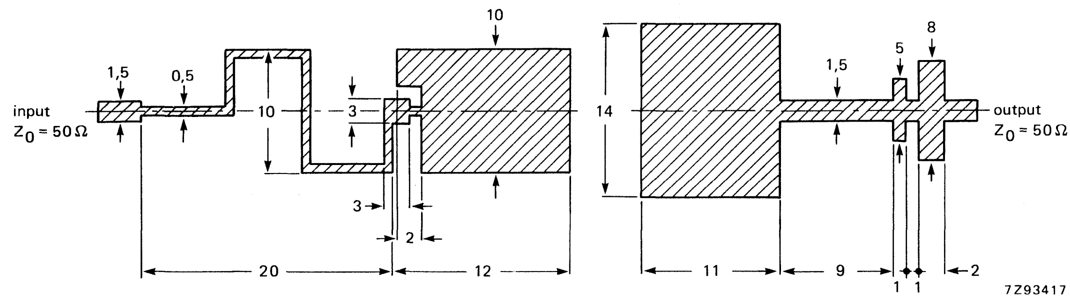


Fig. 4 Premating test circuit board with PTFE fibre-glass dielectric (ϵ_r = 2.54), thickness 0.8 mm.

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

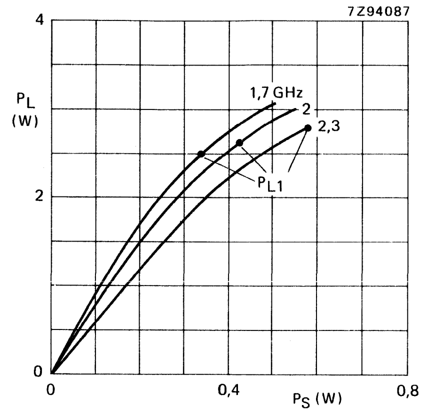


Fig. 5 Output power versus source power.

Conditions for Figs 5 and 6:

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

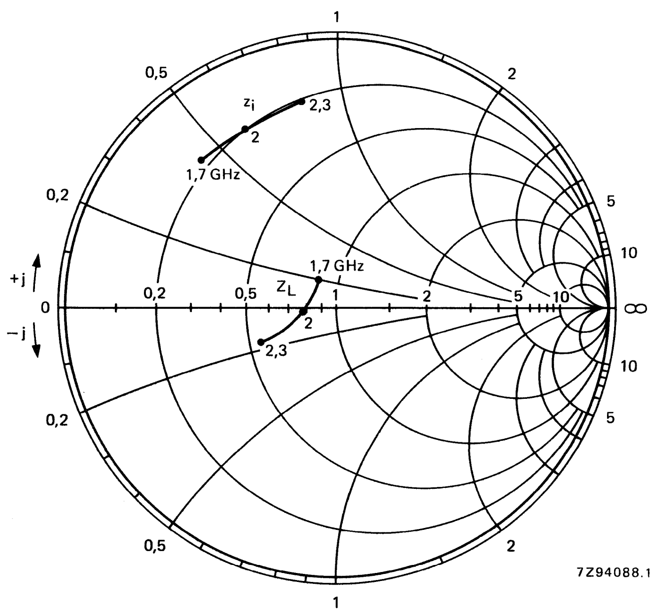


Fig. 6 Input and optimum load impedance versus frequency;
Z_o = 10 Ω; T_{mb} = 25 °C.

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 ^{o}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

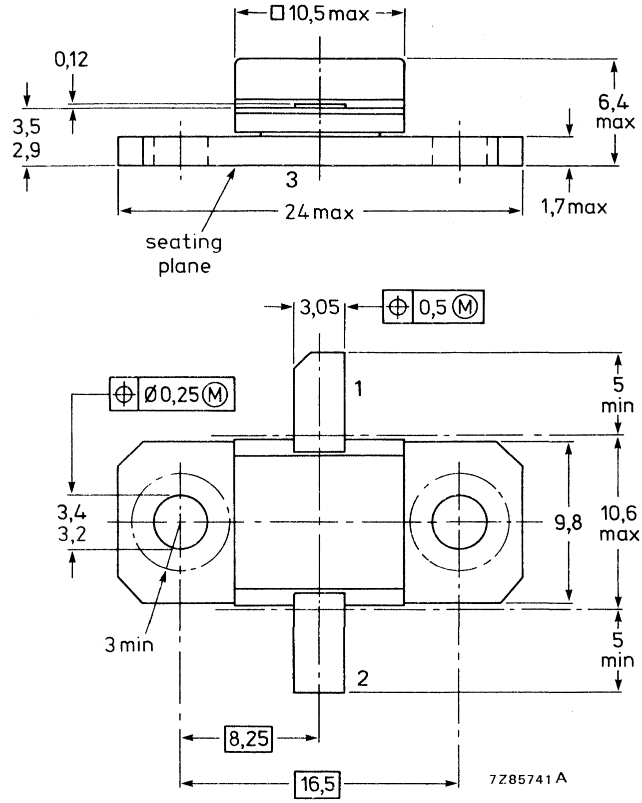
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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

Dimensions in mm

Fig. 1 FO-57C.



Pinning:

1 = collector
2 = base
3 = emitter

Torque on screw: max. 0.5 Nm

Recommended screw: M3

RATINGS

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

→ Collector-base voltage, open emitter	V_{CBO}	max.	45 V
Collector-emitter voltage			
→ open base	V_{CEO}	max.	20 V
→ R_{BE} = 220 Ω	V_{CER}	max.	30 V
Emitter-base voltage, open collector	V_{EBO}	max.	3.5 V
Collector current (DC)	I_C	max.	4 A
Total power dissipation			
→ up to T_{mb} = 75 °C	P_{tot}	max.	45 W
Storage temperature	T_{stg}		−65 to +200 °C
Junction temperature	T_j	max.	200 °C
Soldering temperature			
→ at 0.2 mm from flange; $t_{sld} \leq 10$ s	T_{sld}	max.	235 °C

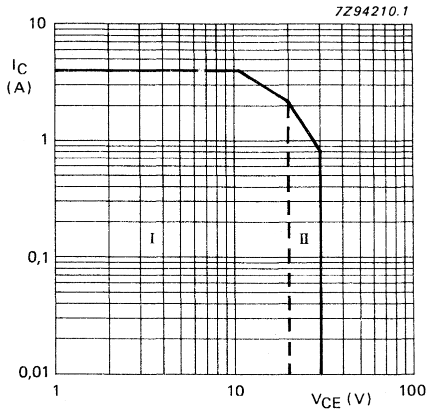


Fig. 2 DC SOAR; $T_{mb} \leqslant 75\ ^oC$.
I Region of permissible DC operation
II Permissible extension provided $R_{BE} \leqslant 220\ \Omega$

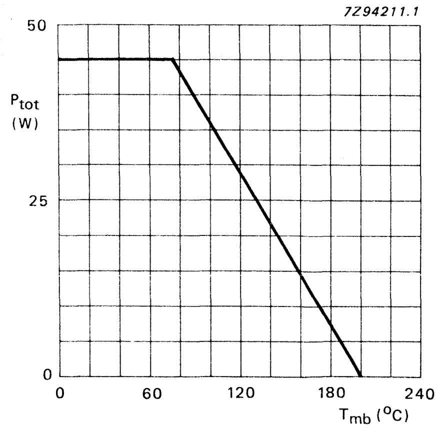


Fig. 3 Power derating curve versus mounting base temperature.

THERMAL RESISTANCE (at $T_j = 75\ ^oC$)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	2.2 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2 K/W

CHARACTERISTICS

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

Collector cut-off current			
$I_E = 0$; $V_{CB} = 20$ V	I_{CBO}	max.	2 mA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	max.	20 mA
$V_{CE} = 30$ V; $R_{BE} = 220\ \Omega$	I_{CER}	max.	20 mA
$V_{CE} = 20$ V; $I_B = 0$	I_{CEO}	max.	20 mA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	200 μA
$I_C = 0$; $V_{EB} = 3.5$ V	I_{EBO}	max.	2.5 mA
DC current gain			
$I_C = 2$ A; $V_{CE} = 3$ V	h_{FE}		15 to 100

APPLICATION INFORMATION

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

mode of operation	f GHz	V_{CE} V	I_C A	P_{L1} W	G_{po} dB	z_i Ω	Z_L Ω
CW; class-A	1.4 to 1.8	16	2	⩾ 9 typ. 10	⩾ 10 typ. 11	see Fig. 7	

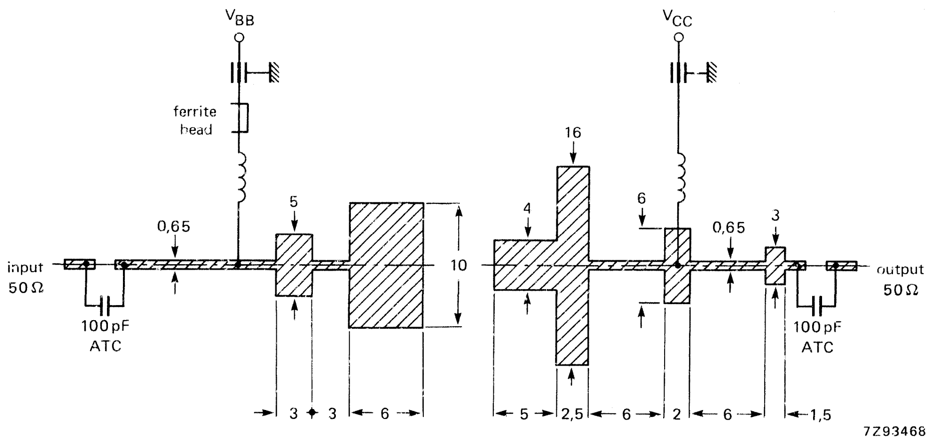


Fig. 4 Wideband test circuit board for 1.4 to 1.8 GHz, CW, class-A application (dimensions in mm). Epsilam p.c. board, thickness 0.635 mm, ϵ_r = 10.

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

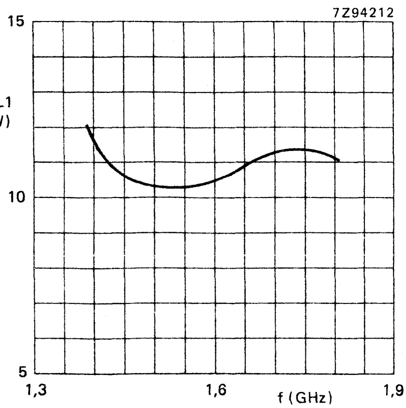


Fig. 5 Load power as a function of frequency.

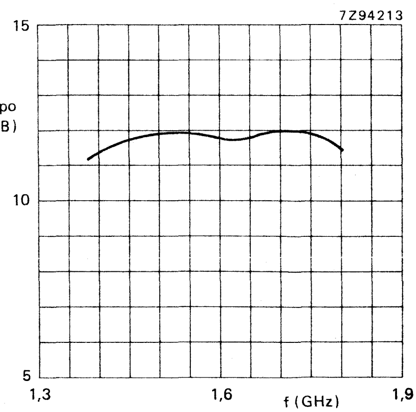


Fig.6 Linear power gain as a function of frequency.

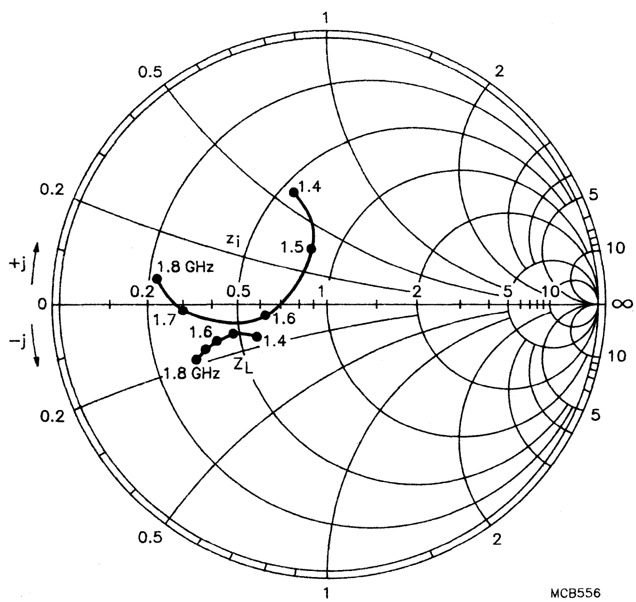


Fig. 7 Input and load impedances as a function of frequency; $Z_O = 10\ \Omega$; typical values.

Conditions for Figs 5 to 7:

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

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 °C in a common emitter class A amplifier.

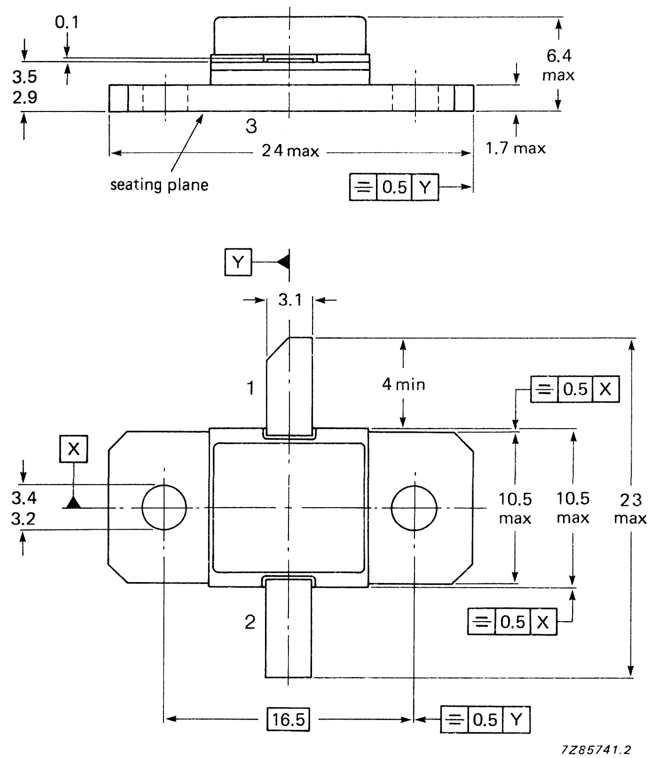
MODE OF OPERATION	f (GHz)	V_{CE} (V)	I_C (mA)	P_{L1} (mW)	G_{po} (dB)
CW; class A	1.8	16	2	typ. 10	typ. 11

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.

MECHANICAL DATA

Dimensions in mm



Torque on screw : max. 0.5 Nm
Recommended screw: M3

Fig.1 FO-57C.

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 Ω	–	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 °C	–	45	W
T_{stg}	storage temperature range		–65	200	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	t_{sld} ≤ 10 s; up to 0.2 mm from flange	–	235	°C

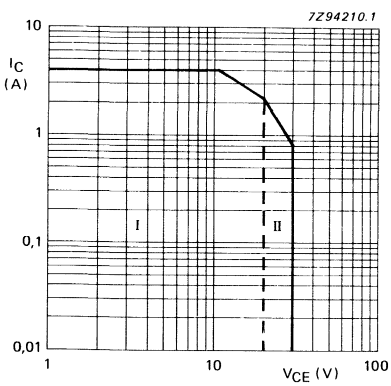


Fig.2 DC SOAR (T_{mb} = 75 °C).
I: Region of permissible DC operation.
II: Permissible extension provided R_{BE} ≤ 220 Ω.

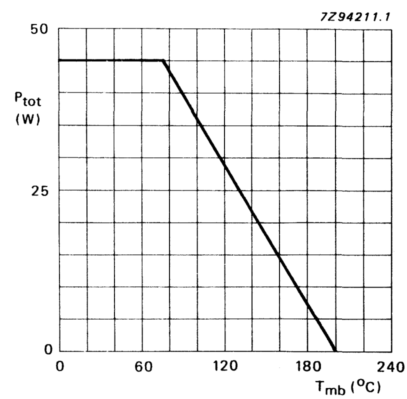


Fig.3 Power derating curve as a function of mounting base temperature.

THERMAL CHARACTERISTICS

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

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 20 V; I_E = 0	–	2	mA
I_{CBO}	collector cut-off current	V_{CB} = 40 V; I_E = 0	–	20	mA
I_{CER}	collector cut-off current	V_{CE} = 30 V; R_{BE} = 220 Ω	–	20	mA
I_{CEO}	collector cut-off current	V_{CE} = 20 V; I_B = 0	–	20	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	–	200	μA
I_{EBO}	emitter cut-off current	V_{EB} = 3.5 V; I_C = 0	–	2.5	mA
h_{FE}	DC current gain	V_{CE} = 3 V; I_C = 2 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 °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 μs δ = 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

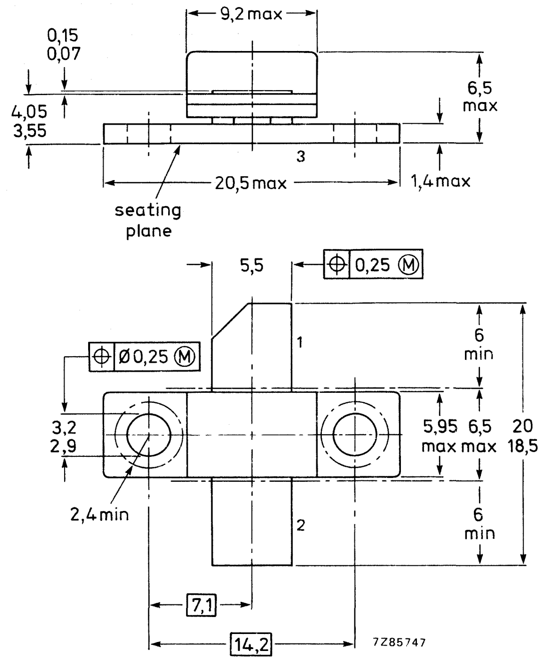
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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

THERMAL RESISTANCE (at T_j=75 ^oC)

From junction to mounting base under pulsed conditions:

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

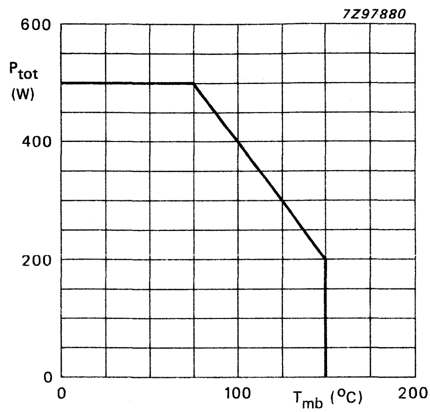


Fig.2 Power derating curve as a function of mounting base temperature in pulsed condition.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Breakdown voltages				
I_C = 40 mA; I_E = 0	$V_{(BR)CBO}$	min.	65	V
I_C = 40 mA; R_{BE} = 0	$V_{(BR)CES}$	min.	65	V
I_C = 0; I_E = 25 mA	$V_{(BR)EBO}$	min.	3.5	V
Collector cut-off current				
I_E = 0; V_{CB} = 50 V	I_{CBO}	max.	15	mA
Emitter cut-off current				
I_C = 0; V_{EB} = 1.5 V	I_{EBO}	max.	1.5	mA
Collector-base capacitance				
I_E = I_C = 0; V_{CB} = 50 V	C_{cb}	typ.	45	pF

APPLICATION INFORMATION

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

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_c %	z_i Ω	Z_L Ω
pulsed: t_p = 10 μs δ = 1%	1.09	50	⩾ 175 typ. 200	⩾ 7.5 typ. 8.5	⩾ 35 typ. 40	see Figs 3 and 4	

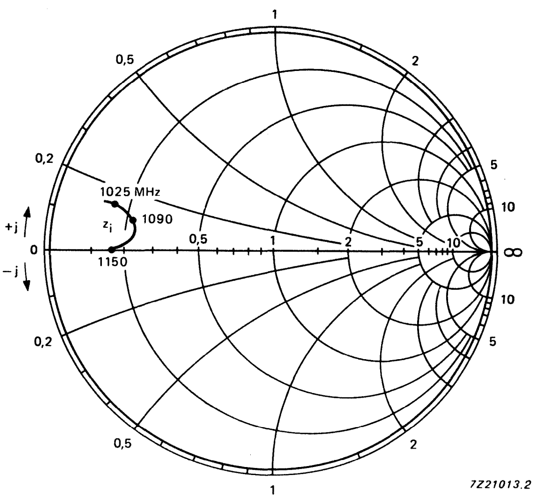


Fig.3 Input impedance as a function of frequency; Z_o = 50 Ω; typical values.

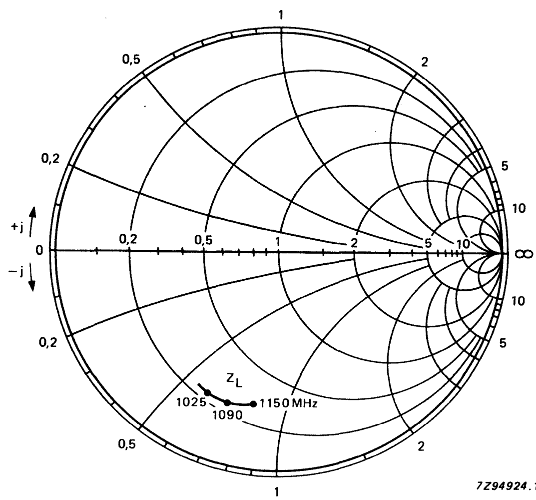


Fig.4 Optimum load impedance as a function of frequency; Z_o = 5 Ω; typical values.

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 °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 μs δ = 1%	1.09	50	⩾350	⩾7	⩾30	see Fig.3	

MECHANICAL DATA

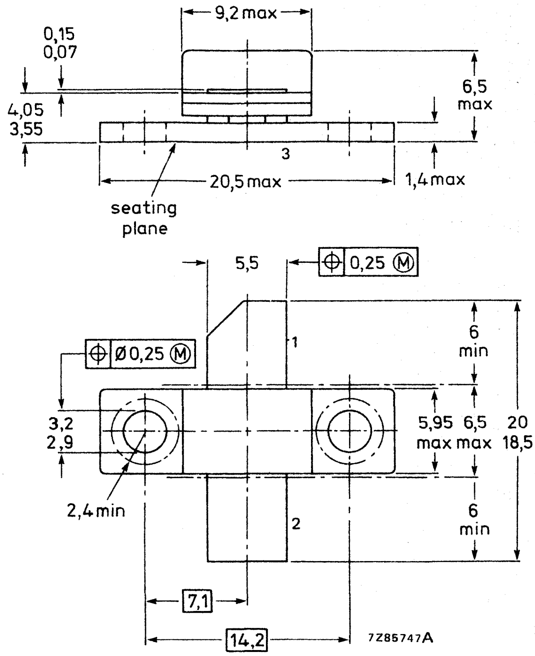
FO-67 (see Fig.1).

WARNING

Product and environmental safety — toxic materials
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.**

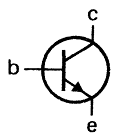
MECHANICAL DATA Dimensions in mm

Fig. 1 FO-67.



Pinning:

1 = collector
2 = emitter
3 = base



Marking code

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

THERMAL RESISTANCE (at Tj=75 ^oC)

From junction to mounting base under pulsed conditions:

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

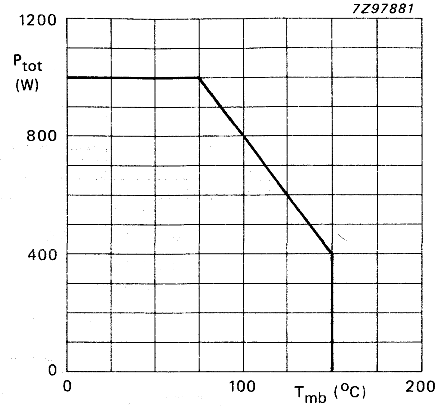


Fig.2 Power derating curve as a function of mouting base temperature; pulsed condition.

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	P_L 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		←

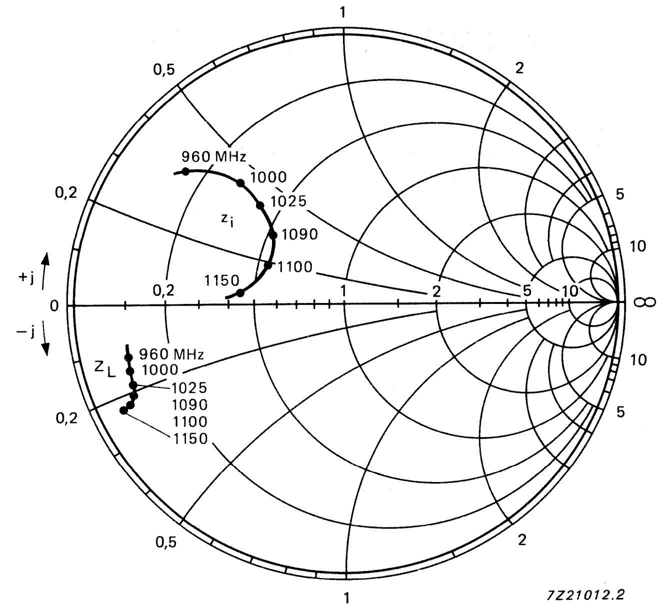


Fig. 3 Optimal load impedance and input impedance in large signal conditions; $Z_O = 10\ \Omega$; typical values.

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 °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 μs δ = 1%	1.09	50	⩾ 800	⩾ 7	> 30	see Fig. 3	

MECHANICAL DATA

FO-96 (see Fig. 1).

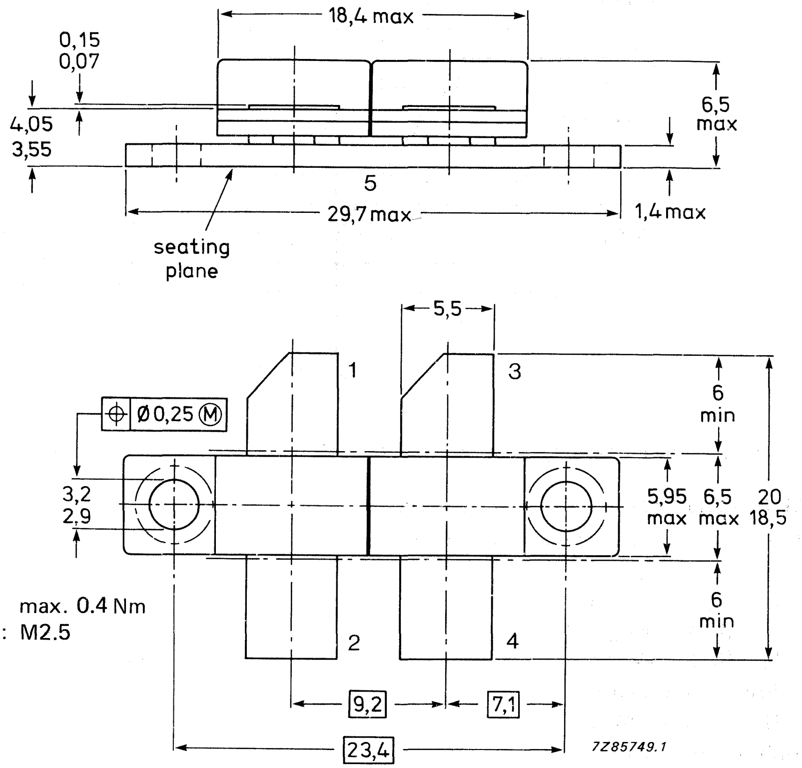
WARNING

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

Dimensions in mm

Fig. 1 FO-96.



Pinning:

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

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

RATINGS

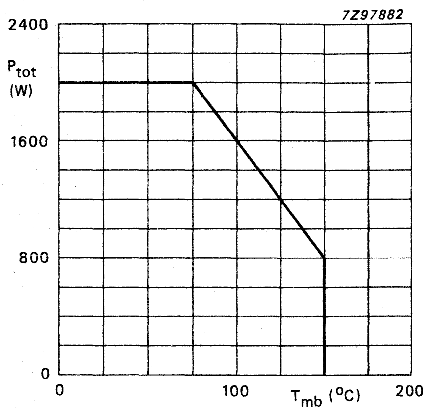
Limiting values in accordance with the Absolute Maximum System (IEC 134)

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

THERMAL RESISTANCE* (at $T_j = 75\ ^oC$)

From junction to mounting base under pulsed conditions:				
→ $t_p \leqslant 10\ \mu s$, $\delta \leqslant 1\%$	$R_{th\ j\text{-}mb}$	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 °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.	10 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-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 μs δ = 1%	1.09	50	⩾ 800 typ. 850	⩾ 7 typ. 7.5	⩾ 30 typ. 35	see Fig. 3		←

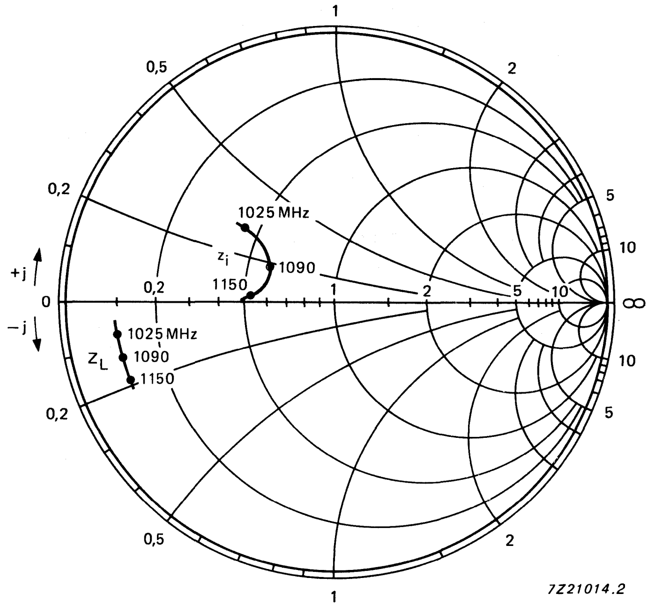


Fig. 3 Input and optimum load impedance in large signal conditions; Z_o = 10 Ω; typical values.

Philips Components

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 °C in a common base class C broadband amplifier.

MODE OF OPERATION	f(GHz)	V_{CC}(V)	P_L(W)	G_p(dB)	ηC(%)	$z_i/Z_L(\Omega)$
class C $t_p = 10\ \mu s$; $\delta = 10\%$	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

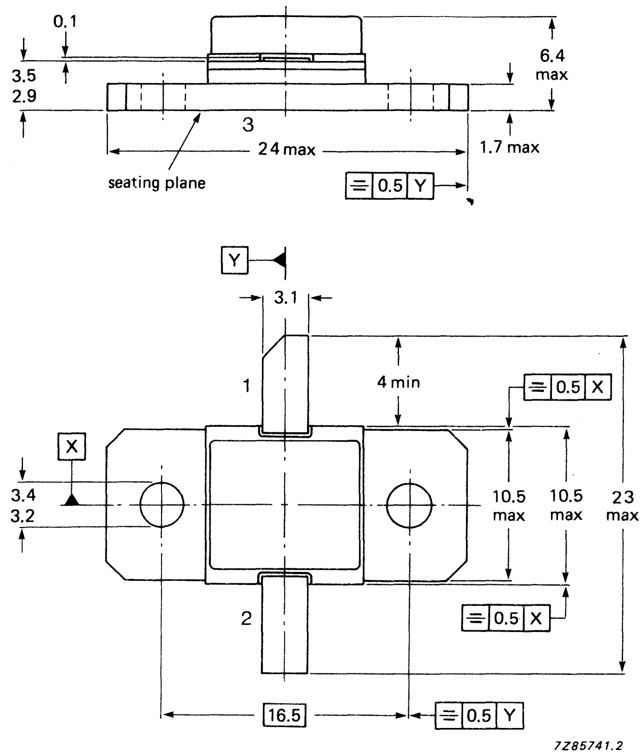


Fig.1 FO-57C.

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; $T_{mb} = 75\ °C$; $t_p \leq 10\ \mu s$; $\delta \leq 10\%$	-	150	W
T_{stg}	storage temperature range		−65	200	°C
T_j	operating junction temperature		-	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s up to 0.2 mm from ceramic	-	235	°C

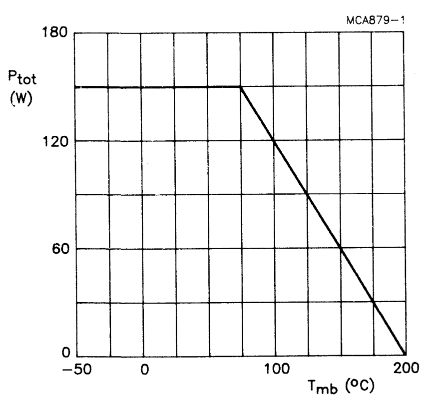


Fig.2 Maximum power dissipation derating as a function of mounting base temperature at $t_p = 10\ \mu s$; $\delta = 10\%$; P_{tot} max = 150 W.

THERMAL CHARACTERISTICS

T_j = 125 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	CW	4.9	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink	CW	0.2	K/W
Z_{th}	thermal impedance from junction to heatsink	note 1	0.85	K/W

Notes

1. Equivalent thermal impedance under nominal pulse microwave operating conditions (t_p = 10 µs and δ = 10%).

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

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

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C measured in the test jig as shown in Fig.3 and working in class C broadband mode in pulse; note 2.

MODE OF OPERATION	f (GHz)	V_{CC} (V) note 1	P_L (W)	G_p (dB)	η C (%)	z_i/Z_L (Ω)
class C t_p = 10 µs; δ = 10%	0.960 to 1.215	50	> 50 typ. 60	> 7 typ. 70	> 42 typ. 44	see Figs 6 and 7

Notes

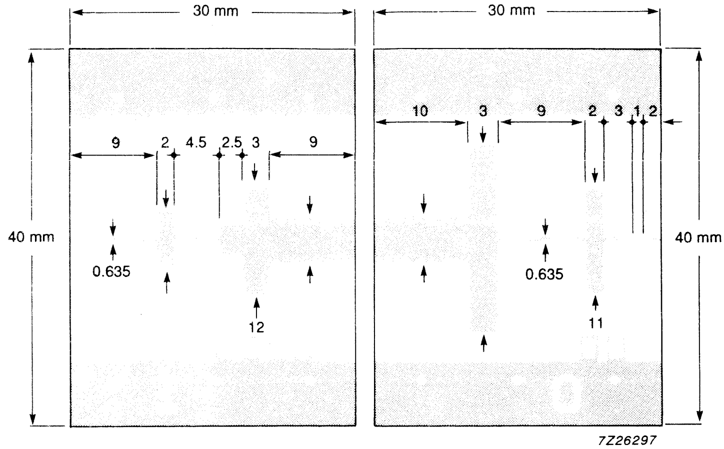
1. V_{CC} during pulse.
2. Operating conditions and performance for other pulse formats can be made available on request.

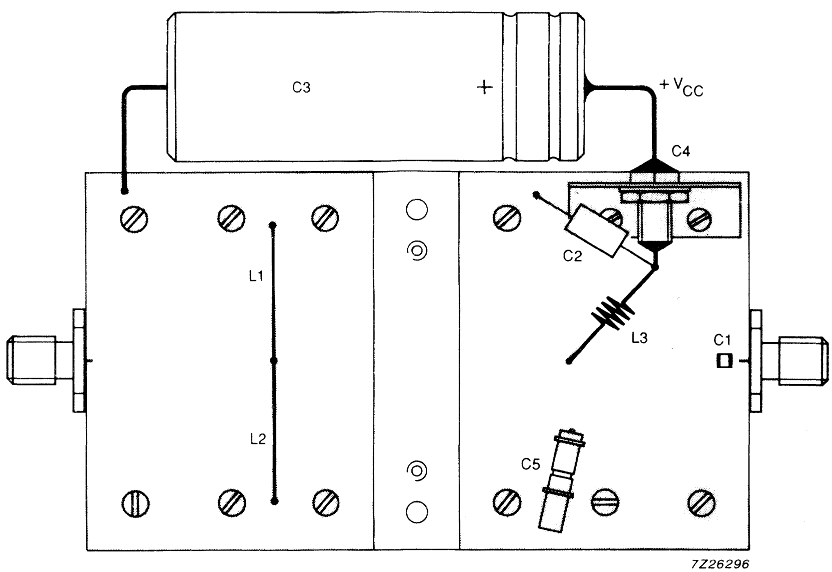
List of components

L1 = L2 = Cu wire ∅ = 0.65 mm, total length = 12 mm, height of loop = 9 mm
L3 = Cu wire ∅ = 0.65 mm, internal diameter 3 mm, 4 turns, L = 5 mm
C1 = DC block, 100 pF (ATC, ref. 100A101KP50X)
C2 = tantalum capacitor 10 µF/50 V
C3 = electrolytic capacitor 470 µF/63 V
C4 = feedthru bypass capacitor (Erie, ref. 1250-003)
C5 = C6 = Variable gigatrim capacitor 0.6 - 4.5 pF, (Tekelec, ref. 727.1)

NPN silicon planar epitaxial microwave power transistor

MZ0912B50Y





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

Fig.3 Broadband test circuit.

NPN silicon planar epitaxial microwave power transistor

MZ0912B50Y

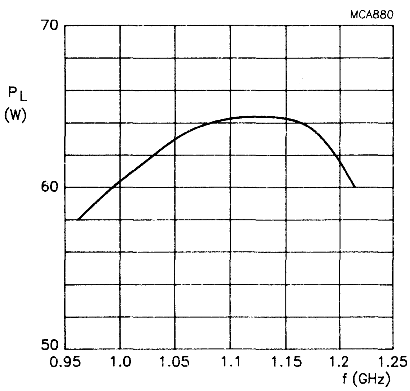


Fig.4 Load power P_L as a function of frequency; V_{CC} = 50 V; t_p = 10 µs; δ = 10%.
(In broadband test circuit as shown in Fig.3).

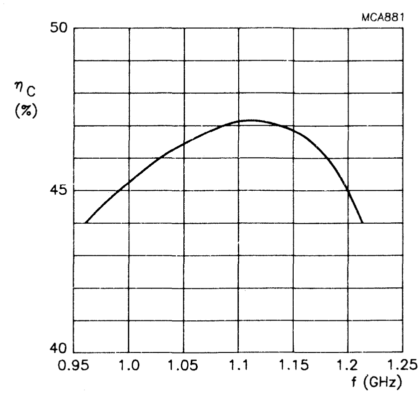


Fig.5 Collector efficiency as a function of frequency.
(In broadband test circuit as shown in Fig.3).

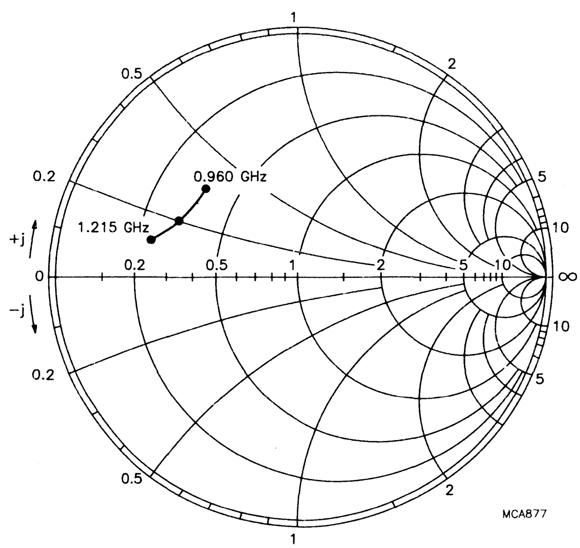


Fig.6 Input impedance as a function of frequency for P_L = 50 W; associated with optimum load impedance; V_{CC} = 50 V; Z_o = 10 Ω.

NPN silicon planar epitaxial microwave power transistor

MZ0912B50Y

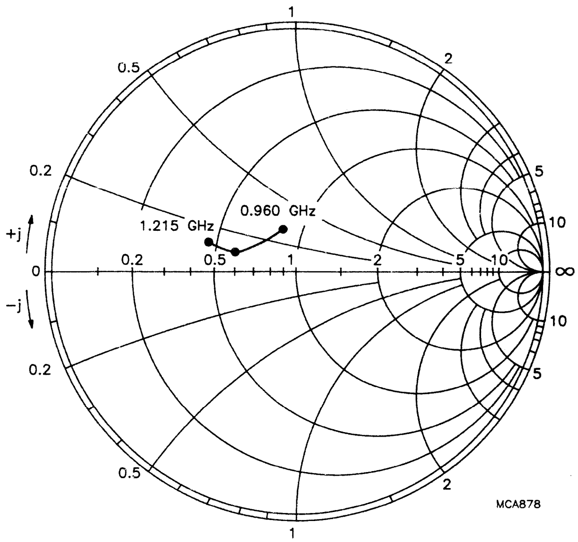


Fig.7 Optimum load impedance as a function of frequency for P_L = 50 W; associated with input impedance; V_{CC} = 50 V; Z_o = 10 Ω.

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.

APPLICATION

Intended for use in common base class C broadband pulse power amplifier from 960 to 1215 MHz for TACAN application.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor intended for use in common base class C broadband pulse power amplifier at 960 to 1215 MHz for TACAN application.
Transistor has a FO-57C metal ceramic flange package, with base connected to flange.
It is mounted in common base configuration, and specified in class C.

QUICK REFERENCE DATA

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

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η C (%)	z_i/Z_L (Ω)
class C; t_p = 10 μs; δ = 10%	0.960 to 1.215	50	> 100	> 7	> 42	see Figs 7 and 8

WARNING

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

MZ0912B100Y

MECHANICAL DATA

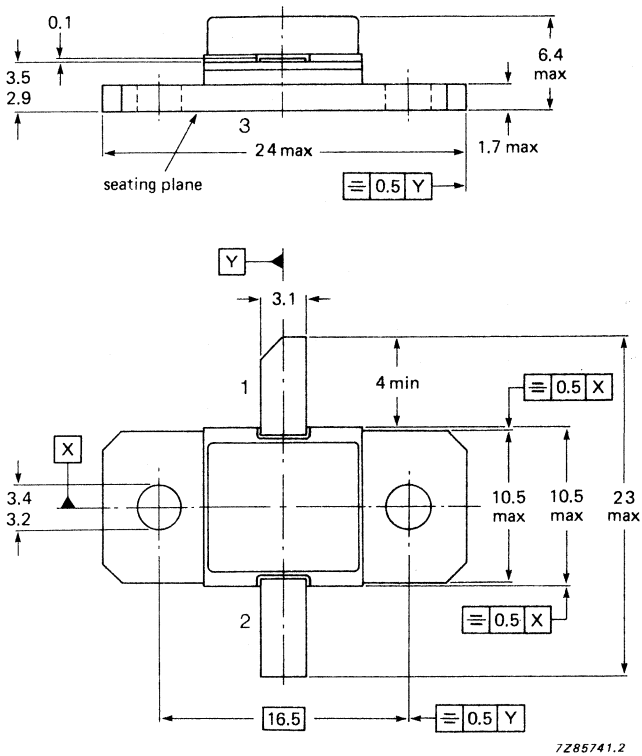


Fig.1 FO-57C.

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

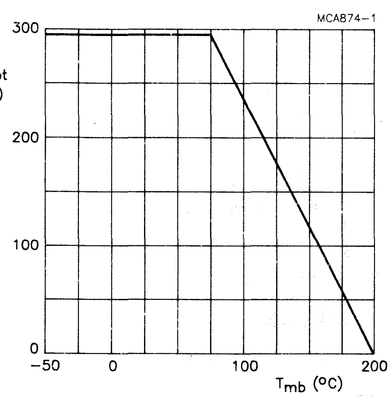


Fig.2 Maximum power dissipation derating as a function of mounting base temperature; $t_p = 10\ \mu s$; $\delta = 10\%$; P_{tot} max = 290 W.

THERMAL CHARACTERISTICS

$T_j = 125\ °C$ unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	CW	3.2	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink	CW	0.2	K/W
Z_{th}	thermal impedance from junction to heatsink	note 1	0.43	K/W

Notes

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

NPN silicon planar epitaxial microwave power transistor

MZ0912B100Y

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

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

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C measured in the test jig as shown in Fig.4 and working in class C broadband mode in pulse; note 2.

MODE OF OPERATION	f (GHz)	V_{CC} (V) note 1	P_L (W)	G_p (dB)	η C (%)	z_i/Z_L (Ω)
class C t_p = 10 μs; δ = 10%	0.960 to 1.215	50	≥ 100 typ. 115	≥ 7 typ. 7.6	≥ 42 typ. 44	see Figs 7 and 8
t_p = 300 μs; δ = 10%	1.03 to 1.09	50	typ. 125	typ. 8	typ. 50	see Fig.3

Notes

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

List of components

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

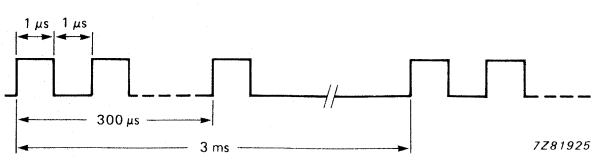
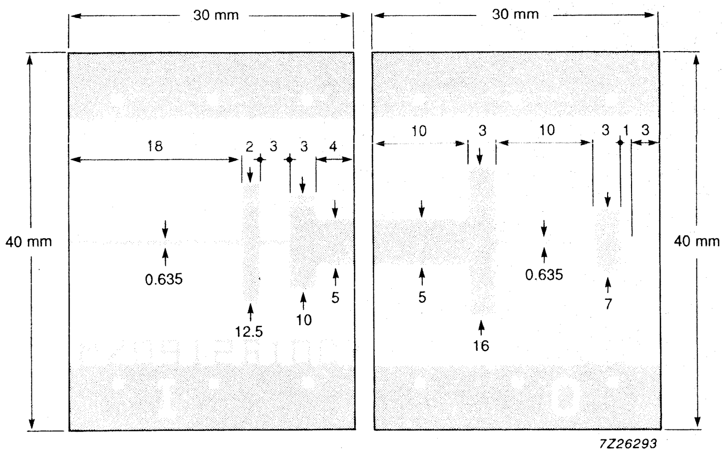
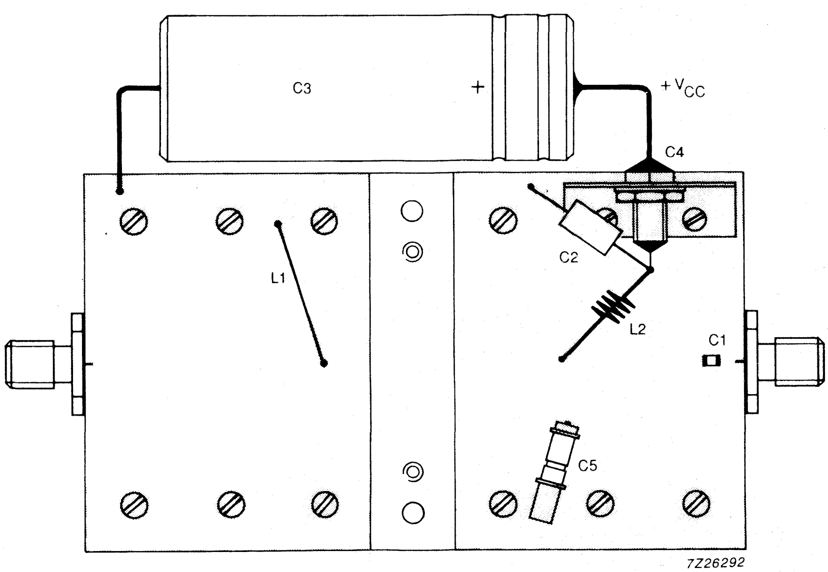


Fig.3 Pulse definition.





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

Fig.4 Broadband test circuit.

NPN silicon planar epitaxial microwave power transistor

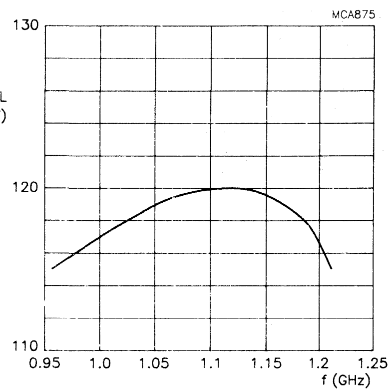


Fig.5 Load power P_L as a function of frequency; V_{CC} = 50 V; t_p = 10 μs; δ = 10%.
(In broadband test circuit as shown in Fig.4).

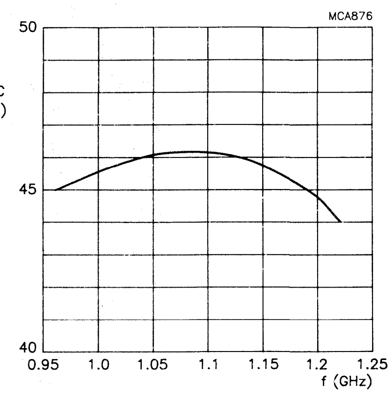


Fig.6 Collector efficiency as a function of frequency.
(In broadband test circuit as shown in Fig.4).

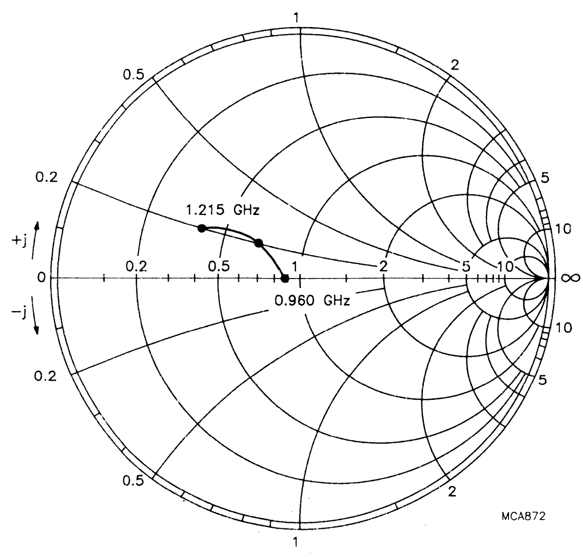


Fig.7 Input impedance as a function of frequency for P_L = 100 W; associated with optimum load impedance; V_{CC} = 50 V; Z_o = 10 Ω.

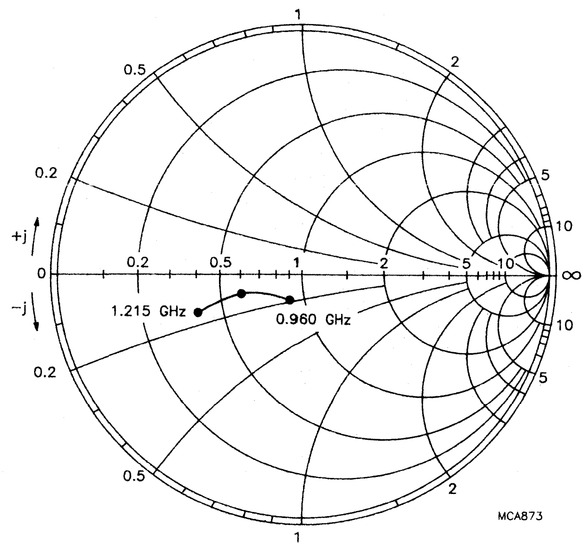


Fig.8 Optimum load impedance as a function of frequency for P_L = 100 W; associated with input impedance; V_{CC} = 50 V; Z_o = 10 Ω.

Philips Components

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 °C in a common base class C broadband amplifier.

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	ηC (%)	z_i/Z_L (Ω)
class C t_p = 10 μs; δ = 10%	0.960 to 1.215	50	> 235	> 7	> 42	see Figs 6 and 7

WARNING

Product and environmental safety - toxic materials

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

MX0912B250Y

MECHANICAL DATA

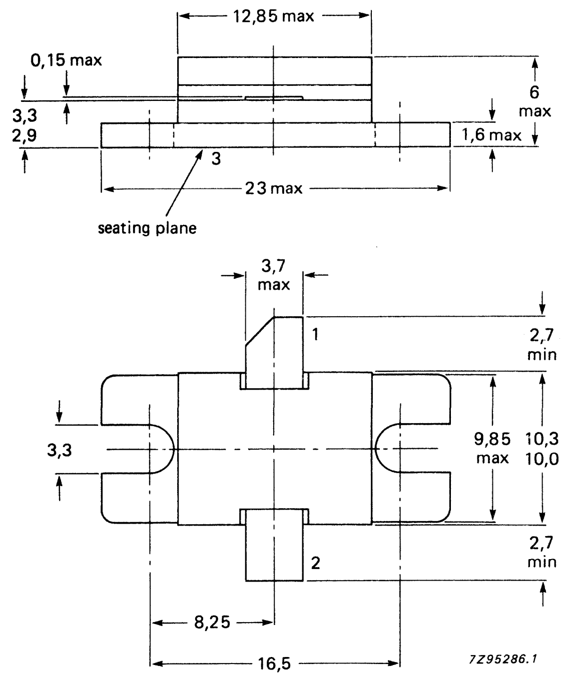


Fig.1 F0-91B.

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	$R_{BE} = 0\ \Omega$	-	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)	$t_p \leq 10\ \mu s$; $\delta \leq 10\%$	-	15	A
P_{tot}	total power dissipation	peak power $T_{mb} = 75\ °C$; $t_p \leq 10\ \mu s$; $\delta \leq 10\%$	-	690	W
T_{stg}	storage temperature range		−65	200	°C
T_j	operating junction temperature		-	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s up to 0.2 mm from ceramic	-	235	°C

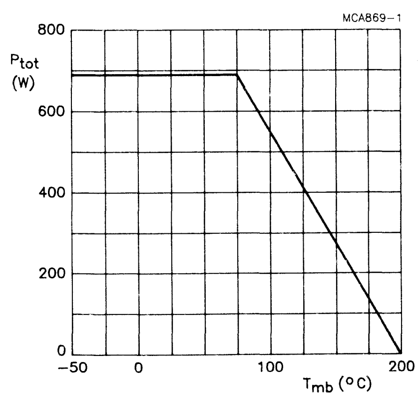


Fig.2 Maximum power dissipation derating as a function of mounting base temperature; $t_p = 10\ \mu s$; $\delta = 10\%$; P_{tot} max = 690 W.

THERMAL CHARACTERISTICS

$T_j = 125\ °C$ unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	CW	1.9	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink	CW	0.2	K/W
Z_{th}	thermal impedance from junction to heatsink	note 1	0.28	K/W

Note

1. Equivalent thermal impedance under nominal pulse microwave operating conditions ($t_p = 10\ \mu s$; $\delta = 10\%$).

NPN silicon planar epitaxial microwave power transistor

MX0912B250Y

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

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

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C measured in the test jig as shown in Fig.4 and working in class C broadband mode in pulse; note 2.

MODE OF OPERATION	f (GHz)	V_{CC} (V) note 1	P_L (W)	G_p (dB)	η C (%)	z_i/Z_L (Ω)
class C t_p = 10 μs; δ = 10%	0.960 to 1.215	50	> 235 typ. 275	> 7 typ. 7.4	> 42 typ. 47	see Figs 6 and 7
t_p = 300 μs; δ = 10%	1.03 to 1.09	50	typ. 280	typ. 8	typ. 48	see Fig.3

Notes

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

List of components

L1 = L2 = Cu wire ∅ = 0.65 mm, total length = 12 mm, height of loop = 9 mm
L3 = Cu wire ∅ = 0.65 mm, internal diameter 3 mm, 4 turns, L = 5 mm
C1 = DC block, 100 pF (ATC, ref. 100A101KP50X)
C2 = tantalum capacitor 10 μF/50 V
C3 = electrolytic capacitor 470 μF/63 V
C4 = feedthru bypass capacitor (Erie, ref. 1250-003)
C5 = C6 = Variable gigatrim capacitor 0.8 - 8 pF, (Tekelec, ref. 729.1)

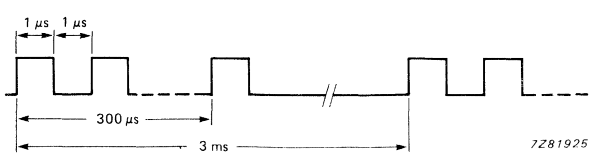
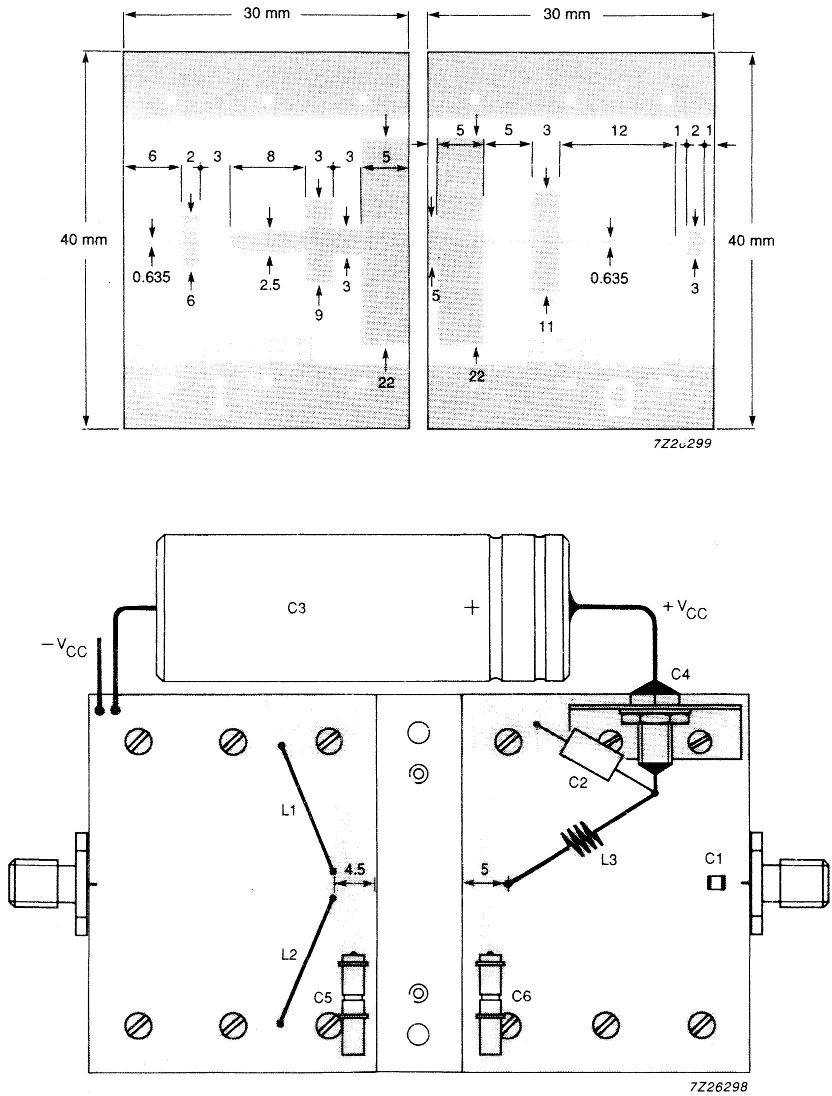


Fig.3 Pulse definition.



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

Fig.4 Broadband test circuit.

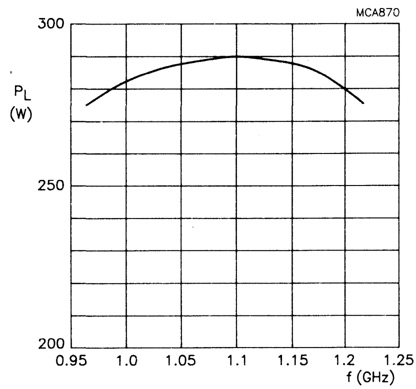


Fig.5 Load power P_L as a function of frequency; V_{CC} = 50 V; t_p = 10 μs; δ = 10%.
(In broadband test circuit as shown in Fig.4).

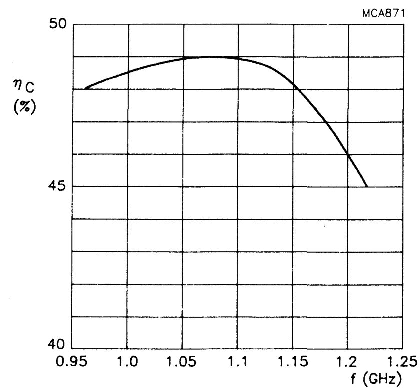


Fig.6 Collector efficiency as a function of frequency.
(In broadband test circuit as shown in Fig.4).

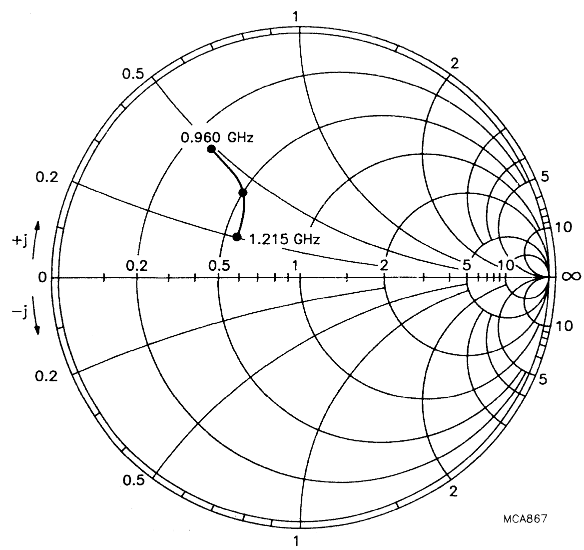


Fig.7 Input impedance as a function of frequency for P_L = 235 W; associated with optimum load impedance; V_{CC} = 50 V; Z_o = 5 Ω.

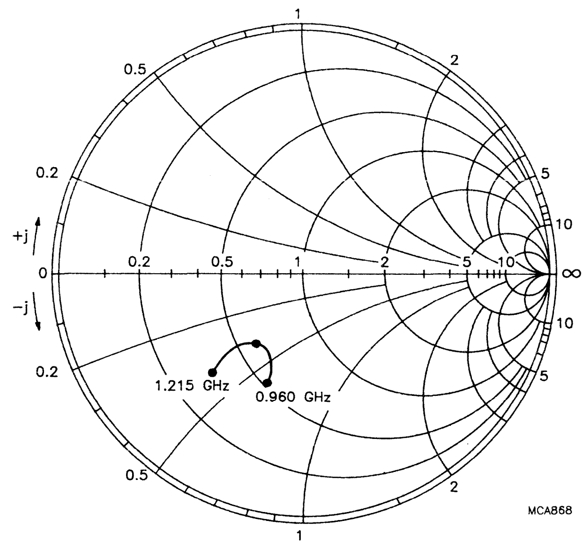


Fig.8 Optimum load impedance as a function of frequency for P_L = 235 W; associated with input impedance; V_{CC} = 50 V; Z_o = 5 Ω.

Philips Components

Data sheet	
status	Preliminary specification
date of issue	June 1990

MX0912B350Y

NPN silicon planar epitaxial microwave power transistor

FEATURES

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

APPLICATION

Intended for use in common base class C broadband pulse power amplifier from 960 to 1215 MHz for TACAN application.

DESCRIPTION

NPN silicon planar epitaxial microwave power transistor intended for use in common base class C broadband pulse power amplifier at 960 to 1215 MHz for TACAN application.
The transistor has a F0-91B metal ceramic flange package, with base connected to flange.
It is mounted in common base configuration, and specified in class C.

QUICK REFERENCE DATA

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

MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	ηC (%)	z_i/Z_L (Ω)
class C t_p = 10 μs; δ = 10%	0.960 to 1.215	50	> 325	> 7	> 40	see Figs 7 and 8

WARNING

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

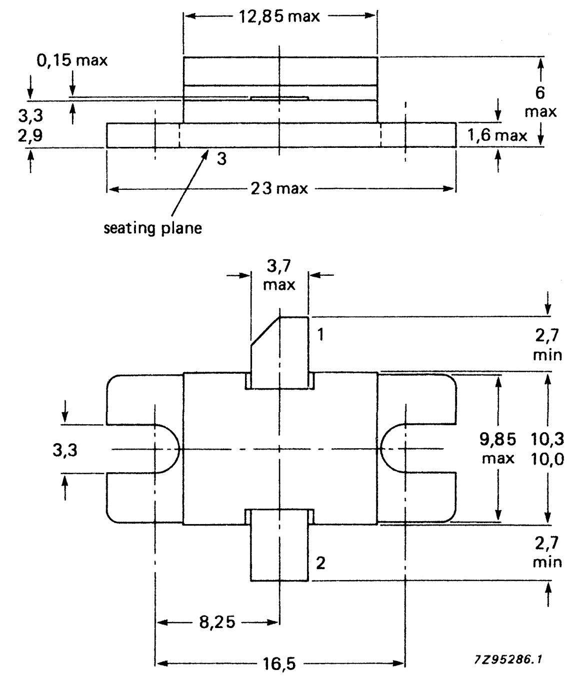


Fig.1 F0-91B.

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_{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)	$t_p \leq 10\ \mu s$; $\delta \leq 10\%$	-	21	A
P_{tot}	total power dissipation	peak power; $T_{mb} = 75\ °C$; $t_p \leq 10\ \mu s$; $\delta \leq 10\%$	-	960	W
T_{stg}	storage temperature range		−65	200	°C
T_j	operating junction temperature		-	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s; up to 0.2 mm from ceramic	-	235	°C

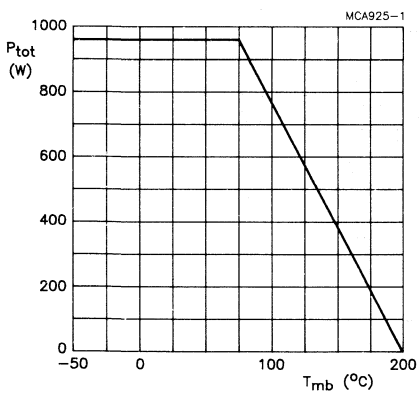


Fig.2 Maximum power dissipation derating as a function of mounting base temperature; $t_p = 10\ \mu s$; $\delta = 10\%$; P_{tot} max = 960 W.

THERMAL CHARACTERISTICS

$T_j = 125\ °C$ unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	CW	1.7	K/W
$R_{th\ mb\text{-}h}$	thermal resistance from mounting base to heatsink	CW	0.2	K/W
Z_{th}	thermal impedance from junction to heatsink	note 1	0.13	K/W

Note

1. Equivalent thermal impedance under nominal pulse microwave operating conditions ($t_p = 10\ \mu s$; $\delta = 10\%$).

NPN silicon planar epitaxial microwave power transistor

MX0912B350Y

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

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

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C measured in the test jig as shown in Fig.4 and working in class C broadband mode in pulse; see also note 2.

MODE OF OPERATION	f (GHz)	V_{CC} (V) note 1	P_L (W)	G_p (dB)	ηC	z_i/Z_L (Ω)
class C t_p = 10 μs = 10%	0.960 to 1.215	50	> 325 typ. 375	> 7 typ. 7.6	> 40 typ. 47	see Figs 7 and 8
t_p = 300 μs; δ = 10%	1.03 to 1.09	50	typ. 350	typ. 8	typ. 48	see Fig.3

Notes

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

List of components

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

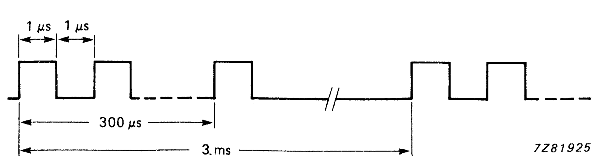
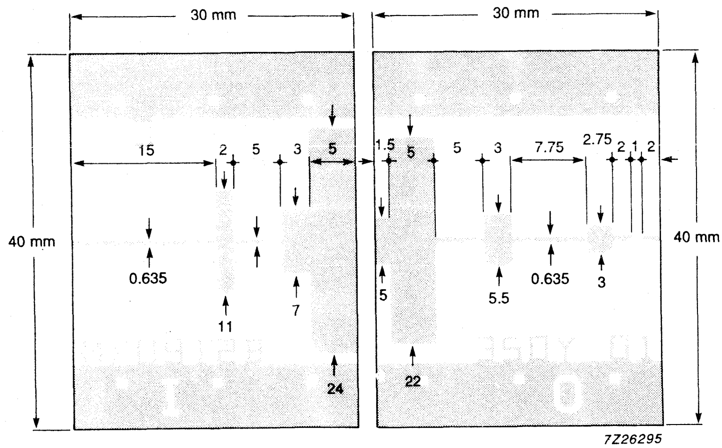
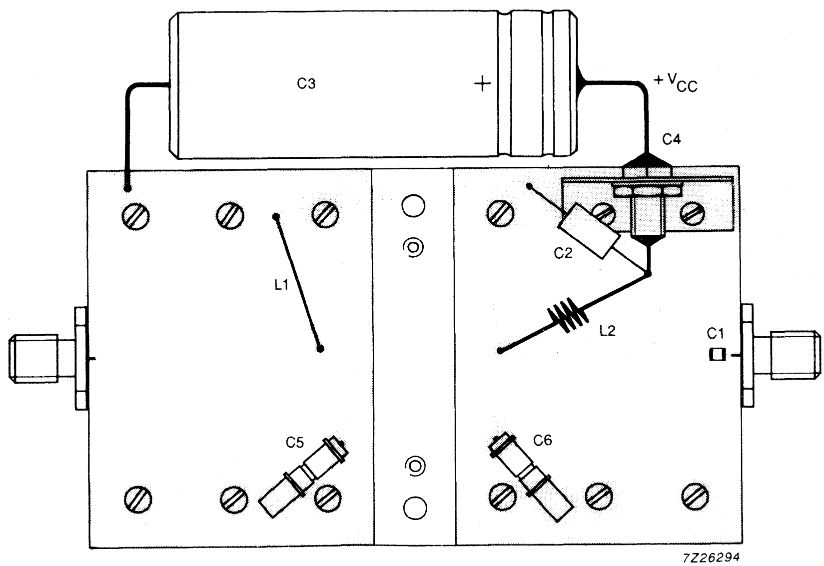


Fig.3 Pulse definition.

NPN silicon planar epitaxial microwave power transistor

MX0912B350Y





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

Fig.4 Broadband test circuit.

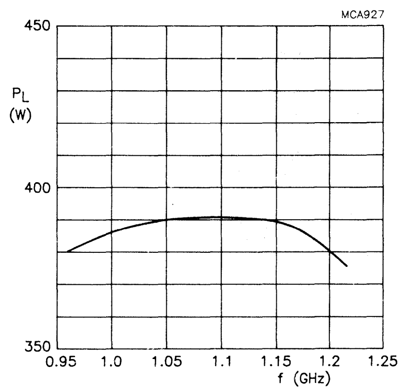


Fig.5 Load power P_L as a function of frequency;
V_{CC} = 50 V; t_p = 10 μs; δ = 10%.
(In broadband test circuit as shown in Fig.4).

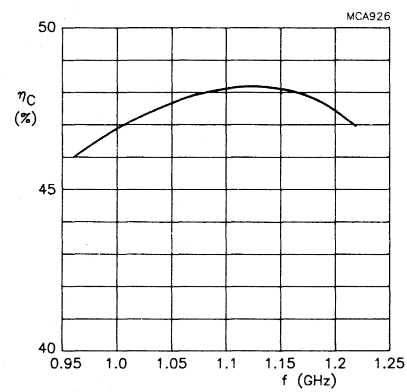


Fig.6 Collector efficiency as a function of frequency;
(In broadband test circuit as shown in Fig.4).

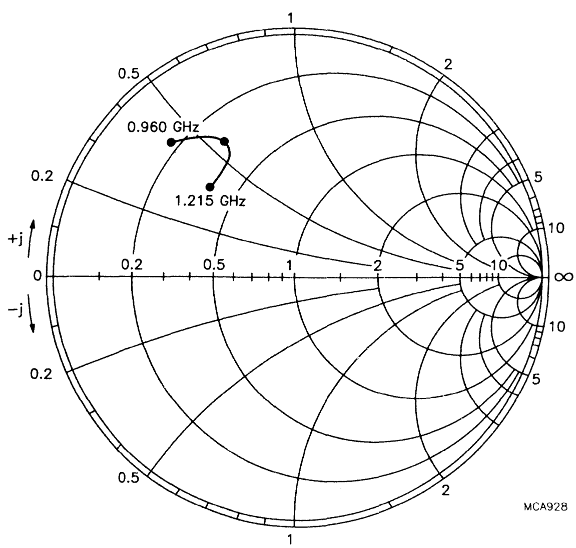


Fig.7 Input impedance as a function of frequency for P_L = 275 W; associated with optimum load impedance;
V_{CC} = 50 V; Z_o = 5 Ω.

NPN silicon planar epitaxial microwave power transistor

MX0912B350Y

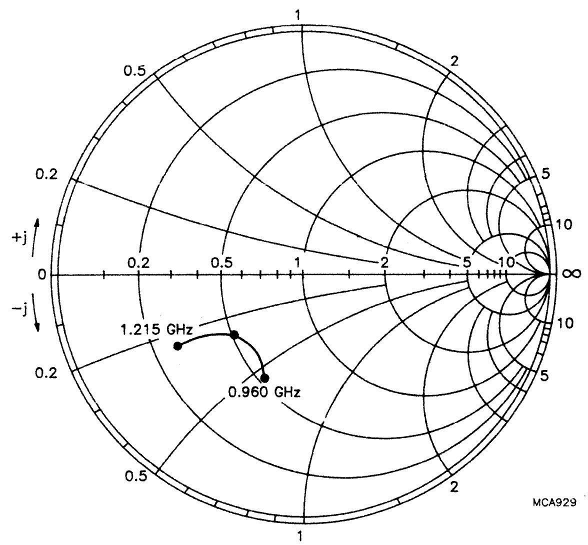


Fig.8 Optimum load impedance as a function of frequency for P_L = 275 W; associated with input impedance; V_{CC} = 50 V; Z_o = 5 Ω.

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 °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 μs 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.

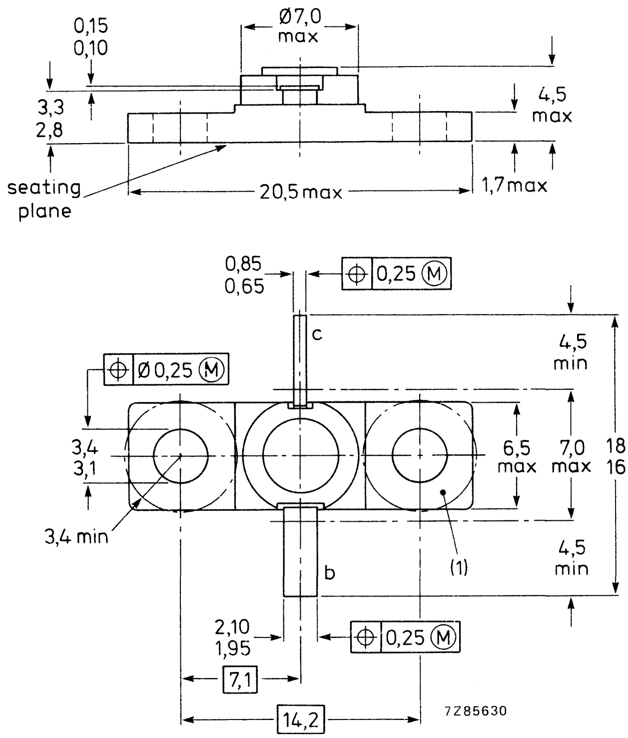
After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general industrial or domestic waste.

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

THERMAL RESISTANCE

From junction to mounting base	$R_{th\ j\text{-}mb}$	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 °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

Dimensions in mm

Fig. 1 FO-53.

Base connected to flange

Pinning

1 = collector
2 = emitter
3 = base

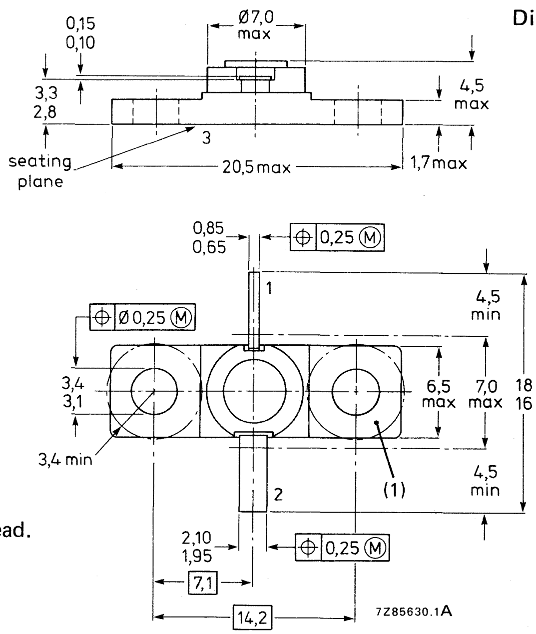
Torque on nut: max. 0.5 Nm

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

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

THERMAL RESISTANCE

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

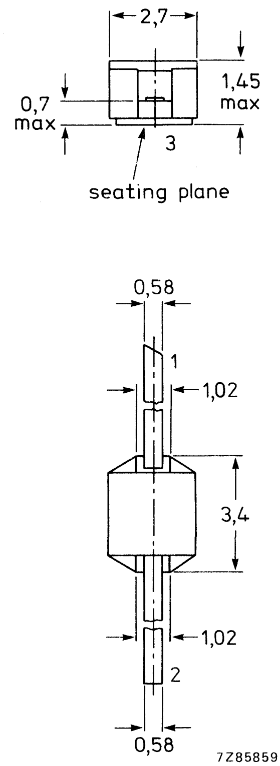
MECHANICAL DATA

PPC5001T FO-102 (see Fig. 1a)
PQC5001T FO-85 (see Fig. 1b).

MECHANICAL DATA

Dimensions in mm

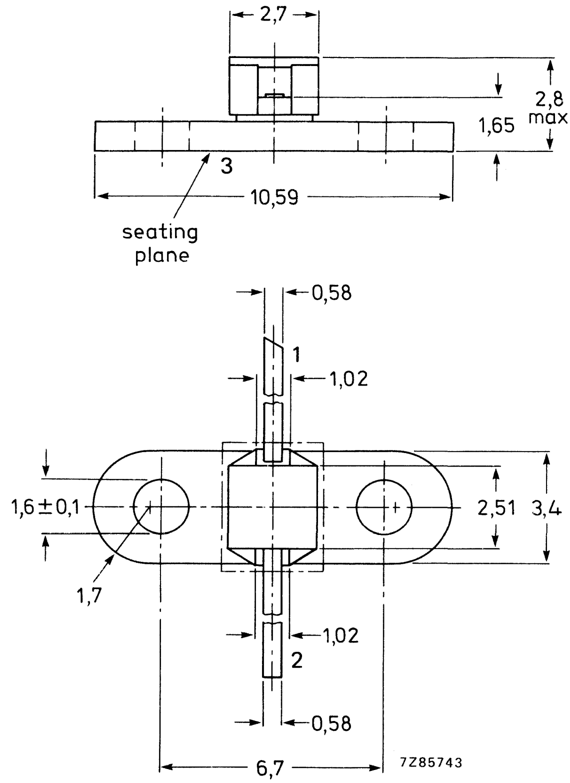
Fig. 1a FO-102.
PPC5001T



Pinning:

1 = base
2 = emitter
3 = collector

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,			
$R_{BE} = 70\ \Omega$	V_{CER}	max.	35 V
open emitter	V_{CEO}	max.	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 $T_{amb} = 75\ ^oC$	P_{tot}	max.	4 W
Storage temperature	T_{stg}		−65 to +200 ^oC
Junction temperature	T_j	max.	200 ^oC
Soldering temperature			
at 0.1 mm from the case, $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 ^oC

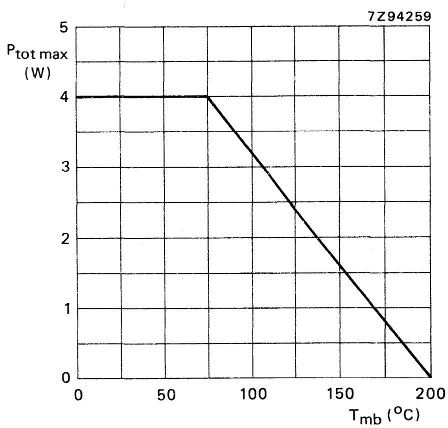


Fig.2 Power derating curve as a function of mounting base temperature.

THERMAL RESISTANCE (at Tj=75 ^oC)

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

CHARACTERISTICS

$T_{mb} = 25\ ^oC$ 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 MHz $I_E = I_C = 0$; $V_{EB} = 1$ V; $V_{CB} = 10$ V	C_{eb}	typ.	5.5 pF
Collector-emitter capacitance at f = 1 MHz $I_E = I_C = 0$; $V_{CE} = 18$ V; $V_{EB} = 1.5$ V	C_{ce}	typ.	0.9 pF

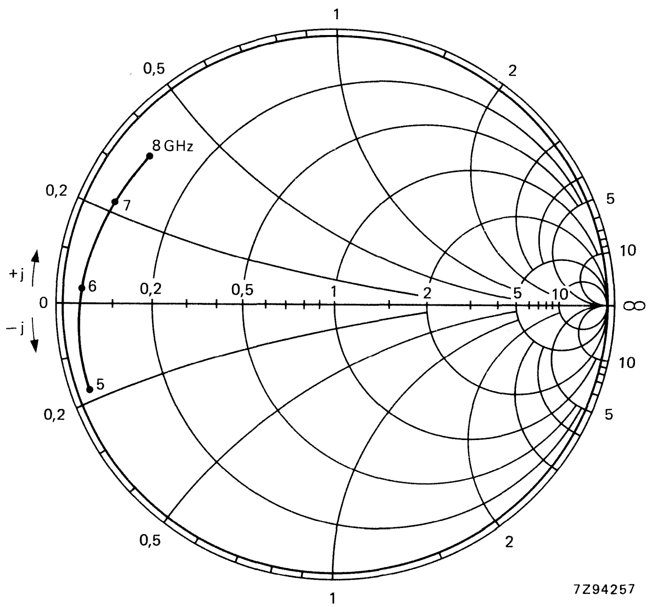


Fig. 3 Emitter reflection coefficient.

Conditions for Figs 3 and 4:

$V_{CE} = 20$ V; $I_C = 200$ mA;
$Z_0 = 50\ \Omega$

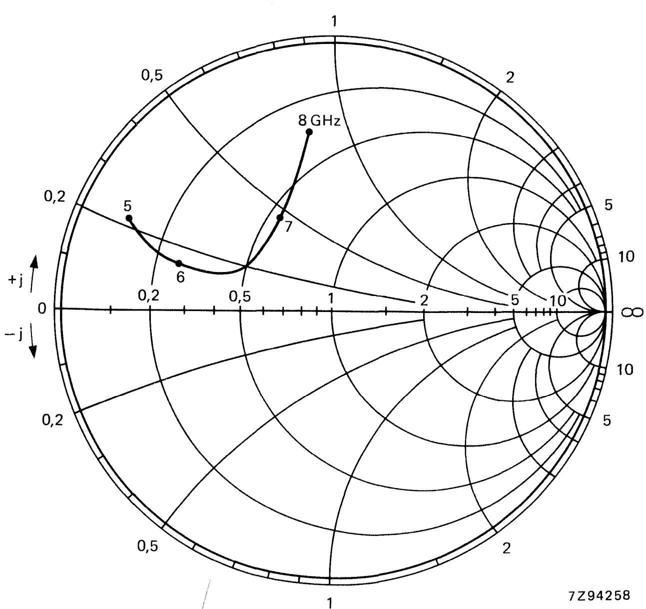


Fig. 4 Base reflection coefficient.

MICROWAVE POWER TRANSISTORS

NPN silicon transistors for use in common-base class-B power amplifiers up to 4.2 GHz.

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

QUICK REFERENCE DATA

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

type number	mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η %	z_i Ω	Z_L Ω
PTB23001X	CW	2	24	⩾ 1	⩾ 7	⩾ 45	8 + j14	8 + j20
PTB23003X	CW	2	24	⩾ 3	⩾ 8.75	⩾ 45	2.5 + j14	8 + j6
PTB23005X	CW	2	24	⩾ 5	⩾ 9.2	⩾ 50	1.9 + j12	7.5 + j3

MECHANICAL DATA

FO-41B (see Fig.1).

WARNING

Product and environmental safety — toxic materials

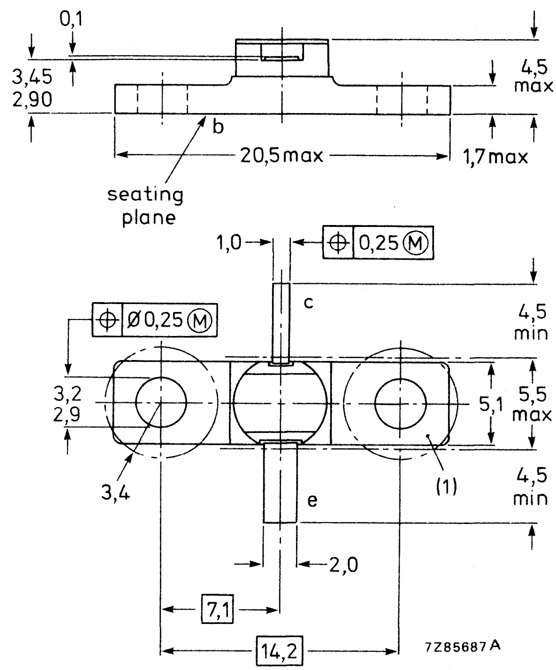
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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.



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 $R_{BE} = 10\ \Omega$	V_{CER}	max.	40	40	40	V
open base	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 $T_{mb} = 75\ ^{o}C$	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; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235			^{o}C

THERMAL RESISTANCE (at T_j = 75 °C)

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

PTB23001X

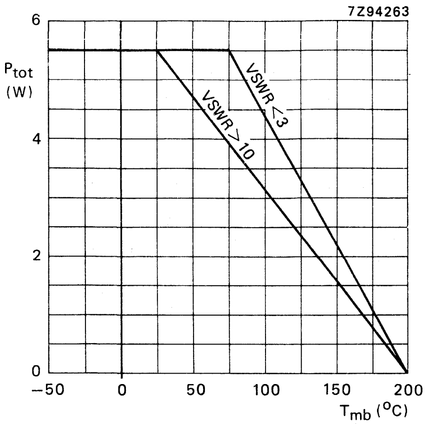


Fig. 2 Maximum permissible RF power dissipation as a function of mounting base temperature; f > 1 MHz.

PTB23003X

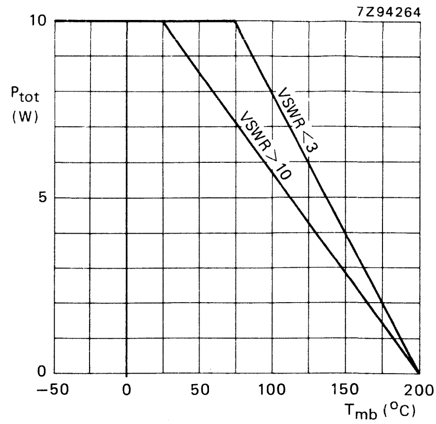


Fig. 3 Maximum permissible RF power dissipation as a function of mounting base temperature; f > 1 MHz.

PTB23005X

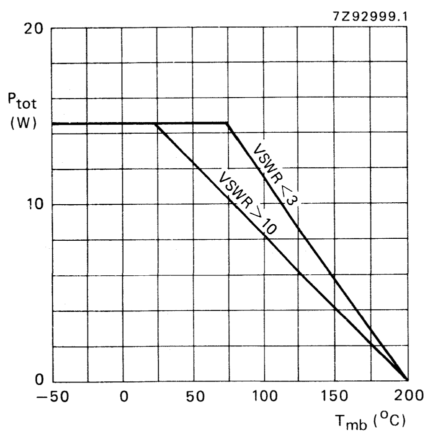


Fig. 4 Maximum permissible RF power dissipation as a function of mounting base temperature; f > 1 MHz.

CHARACTERISTICS

			PTB23001X	23003X	23005X	
Collector-base breakdown voltage						
open emitter; $I_C = 1$ mA		min.	40	–	–	V
open emitter; $I_C = 2$ mA	$V_{(BR)CBO}$	min.	–	40	–	V
open emitter; $I_C = 3$ mA		min.	–	–	40	V
Collector-emitter breakdown voltage						
$R_{BE} = 10\ \Omega$; $I_C = 10$ 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	μA
Emitter cut-off current						
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	0.2	0.4	0.6	μA
Collector-base capacitance at f = 1 MHz						
$I_E = I_C = 0$; $V_{CB} = 24$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	2.2	3	3.8	pF
Collector-emitter capacitance at f = 1 MHz						
$I_E = I_C = 0$; $V_{CB} = 24$ V; $V_{EB} = 1.5$ V	C_{ce}	typ.	0.3	0.6	0.9	pF

APPLICATION INFORMATION

Microwave performance in a common-base class-B selective amplifier circuit.*

type number	mode of operation	f GHz	V_{CE} V	P_L W	G_p dB	η_C %
→ PTB23001X	CW class-B	2	24	> 1 typ. 1.8	> 7 typ. 9	> 45 typ. 50
→ PTB23003X	CW class-B	2	24	> 3 typ. 4	> 8.75 typ. 10	> 45 typ. 50
→ PTB23005X	CW class-B	2	24	> 5 typ. 7	> 9.2 typ. 11	> 40 typ. 50

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

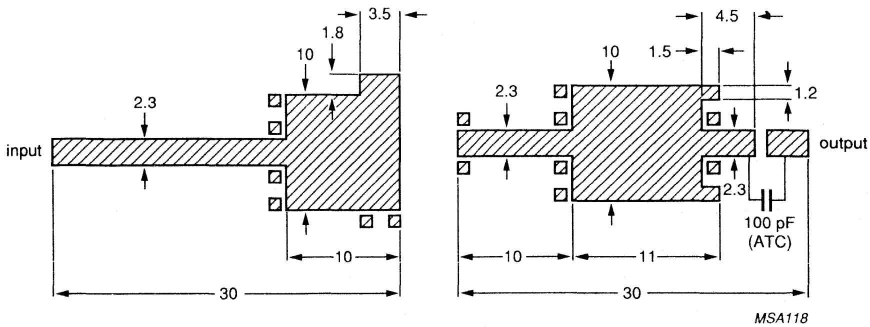


Fig.5 Prematching test circuit board for PTB23001X.

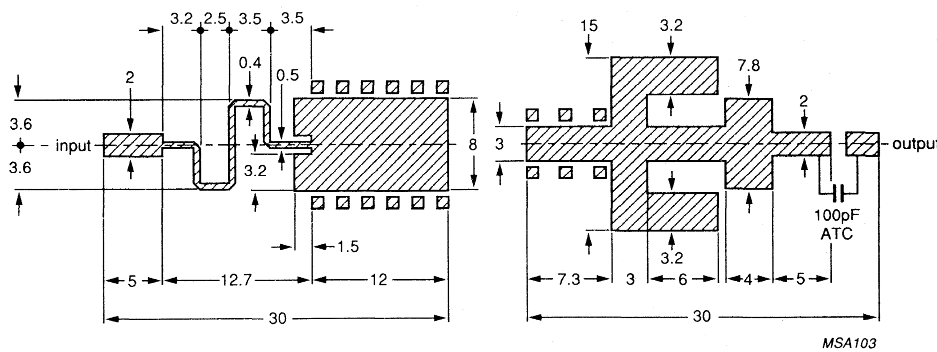


Fig.6 Prematching test circuit board for PTB23003X.

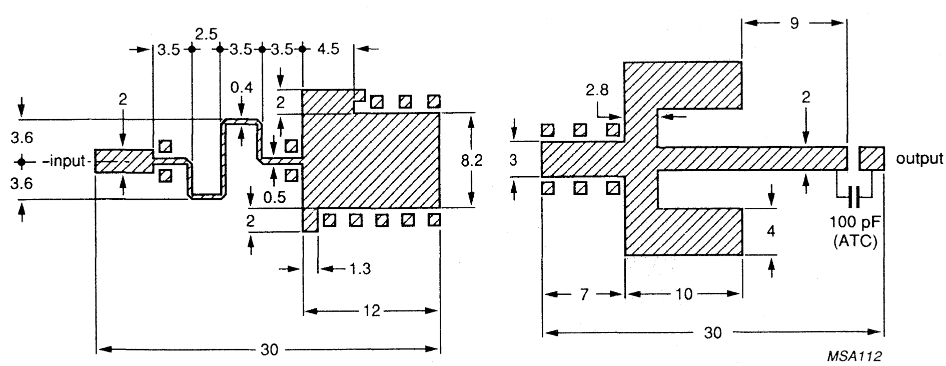


Fig.7 Prematching test circuit board for PTB23005X.

Circuits on a double Cu-clad printed-circuit board Teflon fibre-glass dielectric (ϵ_r = 2.55) thickness 0.8 mm.

MICROWAVE POWER TRANSISTORS

NPN silicon transistors for use in common-base class-B power amplifiers up to 4.2 GHz.

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

QUICK REFERENCE DATA

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

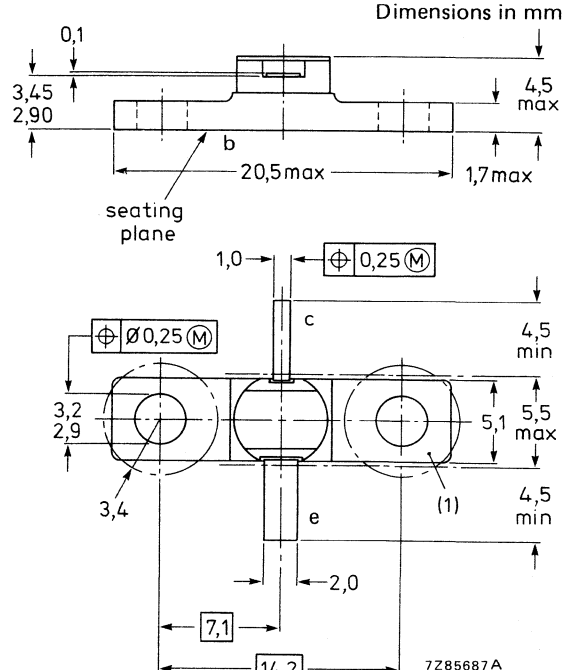
type number	mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η %	z_i Ω	Z_L Ω
PTB32001X	CW	3	24	⩾ 1.3	⩾ 8	⩾ 35	15 + j31	5.5 + j10
PTB32003X	CW	3	24	⩾ 2.5	⩾ 8	⩾ 35	5.5 + j29	5 – j2.2
PTB32005X	CW	3	24	⩾ 4.5	⩾ 8	⩾ 35	2.8 + j20	4 – j7

MECHANICAL DATA

Dimensions in mm

Fig.1 FO-41B.

Base and metallic cap connected to flange.



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 $R_{BE} = 10\ \Omega$	V_{CER}	max.	40	40	40	V
open base	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 $T_{mb} = 75\ ^oC$	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; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235			^oC

THERMAL RESISTANCE (at $T_j = 75\ ^oC$)

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

PTB32001X

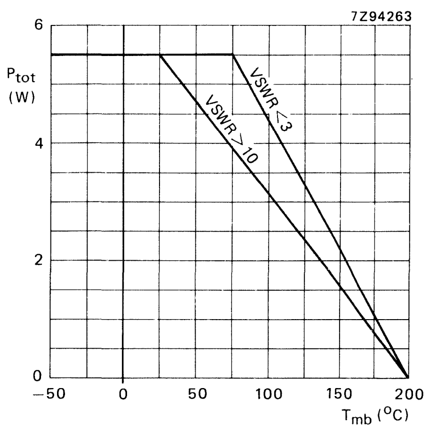


Fig. 2 Maximum permissible RF power dissipation as a function of mounting base temperature. f > 1 MHz.

PTB32003X

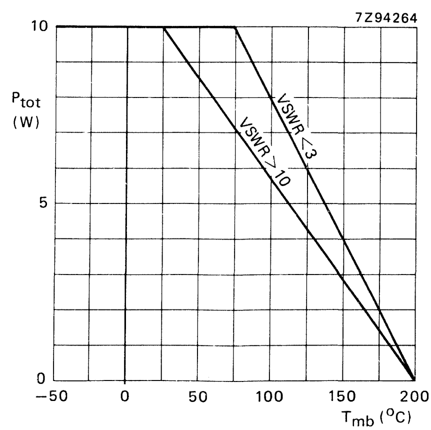


Fig. 3 Maximum permissible RF power dissipation as a function of mounting base temperature. f > 1 MHz.

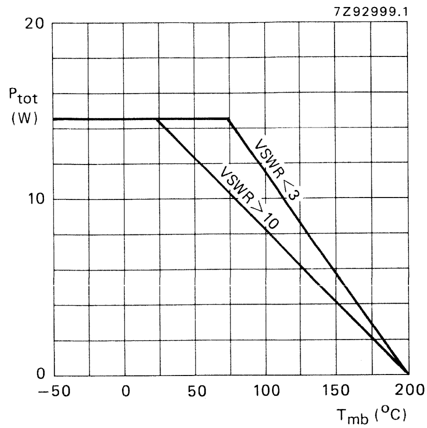


Fig. 4 Maximum permissible RF power dissipation as a function of mounting base temperature. f > 1 MHz.

PTB32005X

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 Ω; 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	μA
Emitter cut-off current						
I_C = 0; V_{EB} = 1.5 V	I_{EBO}	max.	0.2	0.4	0.6	μA
Collector-base capacitance at f = 1 MHz						
I_E = I_C = 0; V_{CB} = 24 V; V_{EB} = 1.5 V	C_{cb}	typ.	2.2	3	3.8	pF
Collector-emitter capacitance at f = 1 MHz						
I_E = I_C = 0; V_{CB} = 24 V; V_{EB} = 1.5 V	C_{ce}	typ.	0.3	0.6	0.9	pF

APPLICATION INFORMATION

Microwave performance in a common-base class-B selective amplifier circuit*

type number	mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %
PTB32001X	CW class-B	3	24	> 1.3 typ. 1.8	> 8 typ. 9.5	> 35 typ. 45
PTB32003X	CW class-B	3	24	> 2.5 typ. 3.0	> 8 typ. 9.5	> 35 typ. 45
PTB32005X	CW class-B	3	24	> 45 typ. 5.5	> 8 typ. 9.5	> 35 typ. 45

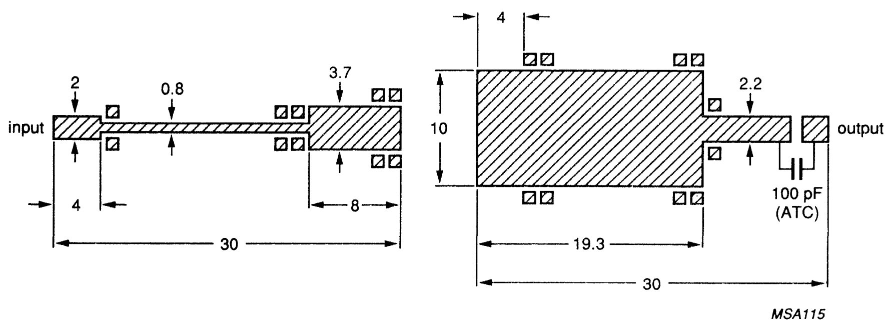


Fig. 5 Prematching test circuit board for PTB32001X.

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

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

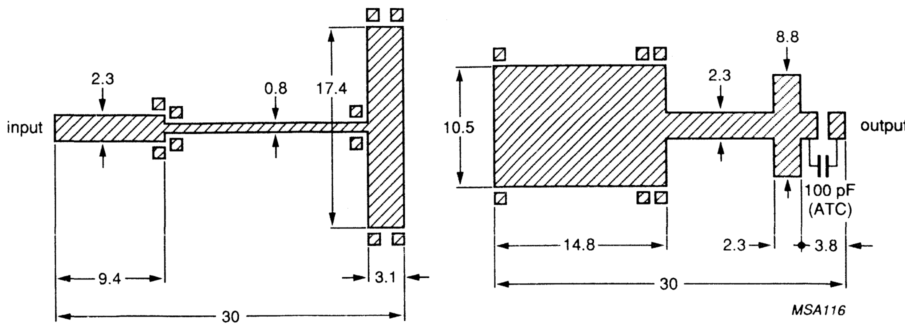


Fig. 6 Prematching test circuit board for PTB32003X.

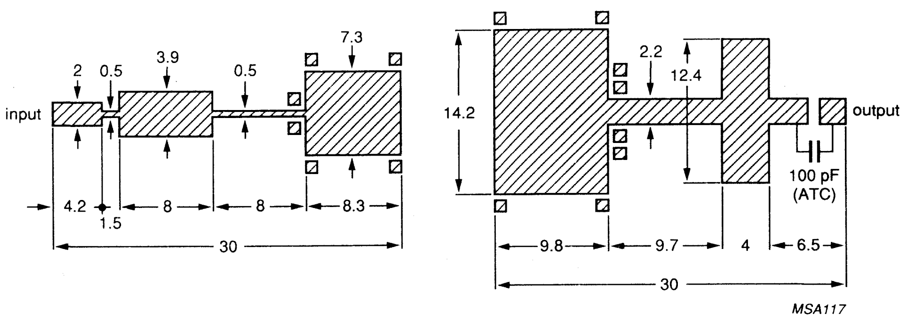


Fig. 7 Prematching test circuit board for PTB32005X.

Circuits on a double Cu-clad printed-circuit board Teflon fibre-glass dielectric (ϵ_r = 2.55); thickness 0.8 mm.

MICROWAVE POWER TRANSISTORS

NPN silicon transistors for use in common-base class-B power amplifiers up to 4.2 GHz.

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

QUICK REFERENCE DATA

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

type number	mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η %	z_i Ω	Z_L Ω
PTB42001X	CW	4.2	24	⩾ 0.8	> 5	> 28	235 + j0	3.3 – j5.8
PTB42002X	CW	4.2	24	⩾ 1.6	> 5	> 28	44.5 + j85	2.4 – j15.5

MECHANICAL DATA

Dimensions in mm

Fig.1 FO-41B.

Base and metallic cap connected to flange.

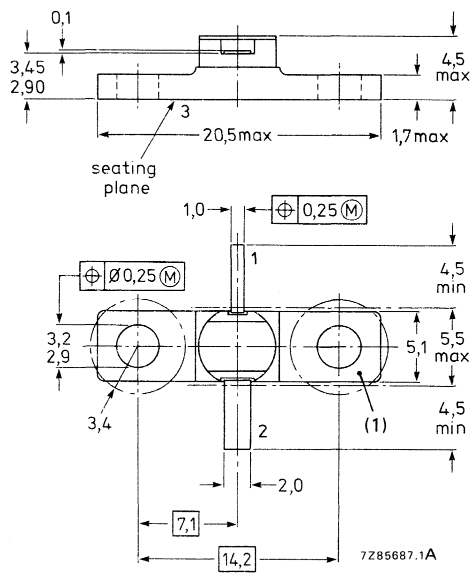
Pinning

1 = collector
2 = emitter
3 = base

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

Marking code

4201X = PTB42001X
4202X = PTB42002X



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

WARNING

Product and environmental safety – toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO 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					
$R_{BE} = 10\ \Omega$	V_{CER}	max.	40	40	V
open base	V_{CEO}	max.	15	15	V
Emitter-base voltage					
open collector	V_{EBO}	max.	3.5	3.5	V
Collector current (DC)	I_C	max.	0.25	0.5	A
RF power dissipation (f > 1 MHz)					
up to T_{mb} = 75 °C	P_{tot}	max.	5,5	10	W
Storage temperature range	T_{stg}		−65 to + 200		°C
Junction temperature	T_j	max.	200		°C
Lead soldering temperature					
at 0.3 mm from ceramic; $t_{sld} \leq 10$ s	T_{sld}	max.	235		°C

PTB42001X

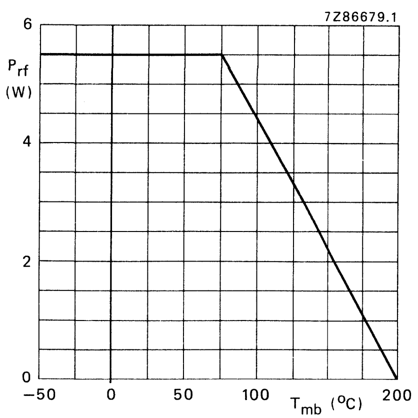


Fig. 2 Maximum permissible RF power dissipation as a function of mounting base temperature; f > 1 MHz.

PTB42002X

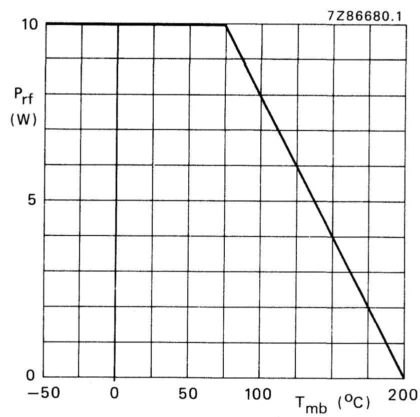


Fig. 3 Maximum permissible RF power dissipation as a function of mounting base temperature; f > 1 MHz.

THERMAL RESISTANCE (at T_j = 75 °C)

			PTB42001X	42002X	
From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	22	12	K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.7	0.7	K/W

CHARACTERISTICS

			PTB42001X	42002X	
Collector-base breakdown voltage					
open emitter; $I_C = 1$ mA	$V_{(BR)CBO}$	min.	40	–	V
open emitter; $I_C = 2$ mA	$V_{(BR)CBO}$	min.	–	40	V
Collector-emitter breakdown voltage					
$R_{BE} = 10\ \Omega$; $I_C = 10$ mA	$V_{(BR)CER}$	min.	40	40	V
Emitter-base breakdown voltage					
open collector; $I_E = 0.5$ mA	$V_{(BR)EBO}$	min.	3.5	–	V
open collector; $I_E = 1.0$ mA	$V_{(BR)EBO}$	min.	–	3.5	V
Collector cut-off current					
$I_E = 0$; $V_{CB} = 24$ V	I_{CBO}	max.	10	20	μA
Emitter cut-off current					
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	0.2	0.4	μA
Collector-base capacitance at f = 1 MHz					
$I_E = I_C = 0$; $V_{CB} = 24$ V; $V_{EB} = 1.5$ V	C_{cb}	typ.	2.2	3	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	pF

APPLICATION INFORMATION (see also next page)

PTB42001X

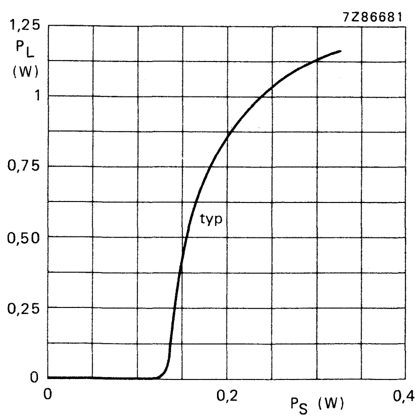


Fig. 4 Load power as a function of source power.

PTB42002X

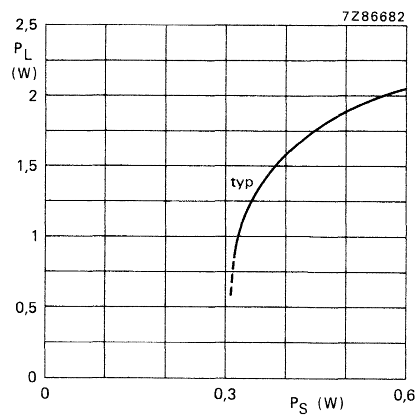


Fig. 5 Load power as a function of source power.

Conditions for Figs 4 and 5:

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

APPLICATION INFORMATION (see also previous page)

RF performance up to T_{mb} = 25 °C in a common-base class-B circuit*

type number	mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η %	z_i Ω	Z_L Ω
PTB42001X	CW	4.2	24	> 0.8 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

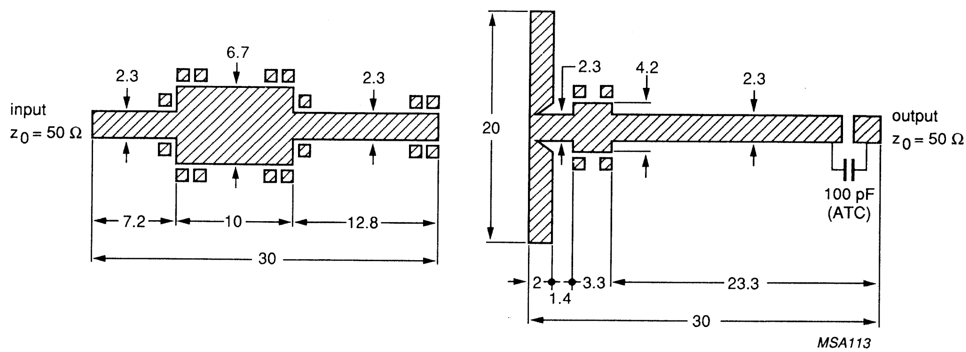


Fig. 6 Prematching test circuit boards for the **PTB42001X** at 4.2 GHz (Dimensions in mm.)

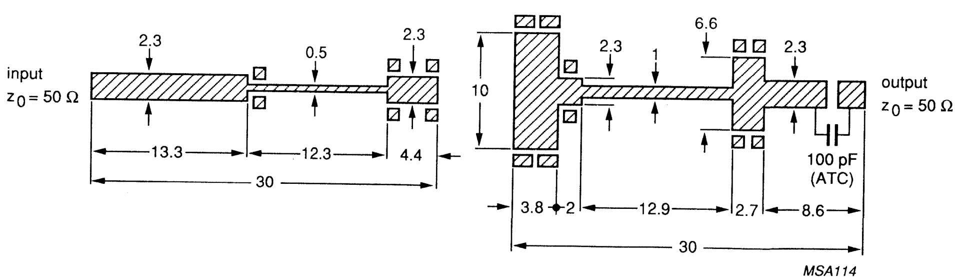


Fig. 7 Prematching test circuit boards for the **PTB42002X** at 4.2 GHz. (Dimensions in mm.)

Circuits on a double Cu-clad printed-circuit board PTFE fibre-glass dielectric (ϵ_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 °C in a common-base class-C selective amplifier

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
CW; class-C	4.2	24	⩾ 2.5	⩾ 5	⩾ 28	12 + j35	2.5 − j10

MECHANICAL DATA

Dimensions in mm

FO-41B (see Fig.1).

WARNING

Product and environmental safety — toxic materials

This product contains beryllium oxide. The product is entirely safe provided that the BeO 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-41-B.

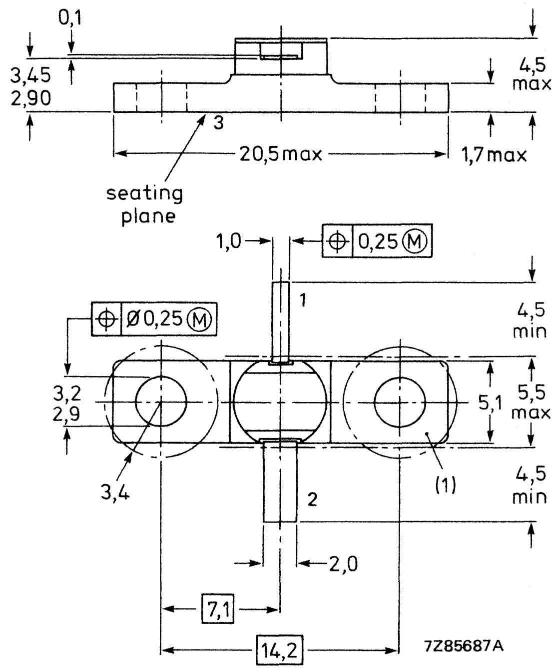
Dimensions in mm

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; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 °C

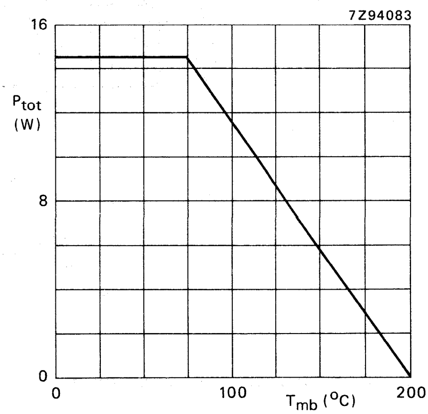


Fig.2 Power derating curve as a function of mounting base temperature.

THERMAL RESISTANCE (at T_j = 75 °C)

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

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Breakdown voltages			
$I_C = 3$ mA; $I_E = 0$	$V_{(BR)CBO}$	min.	40 V
$I_C = 10$ mA; $R_{BE} = 10\ \Omega$	$V_{(BR)CER}$	min.	40 V
$I_C = 0$; $I_E = 1$ mA	$V_{(BR)EBO}$	min.	3.5 V
Collector cut-off current			
$I_E = 0$; $V_{CB} = 24$ V	I_{CBO}	max.	30 μA
Emitter cut-off current			
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	0.6 μA
Collector-base capacitance			
$I_E = I_C = 0$; $V_{CB} = 24$ V	C_{cb}	typ.	3.8 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	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

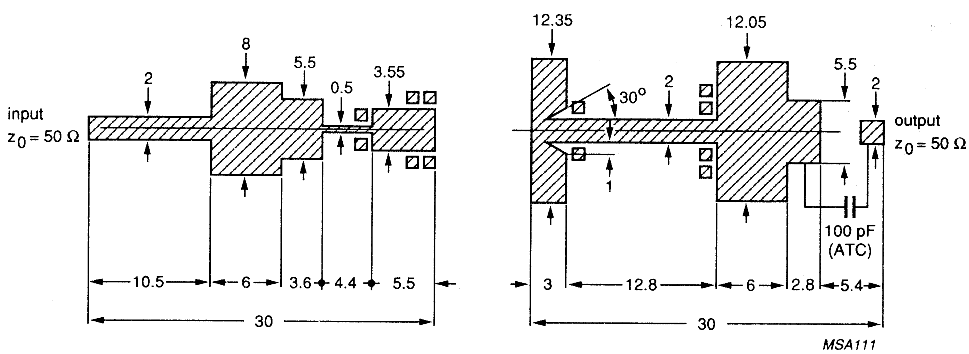


Fig.3 Prematching test circuit board for 4.2 GHz. (Dimensions in mm).

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

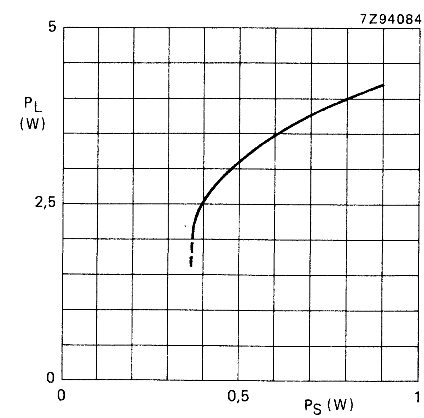


Fig.4 Load power as a function of source power.

* 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 ^oC 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

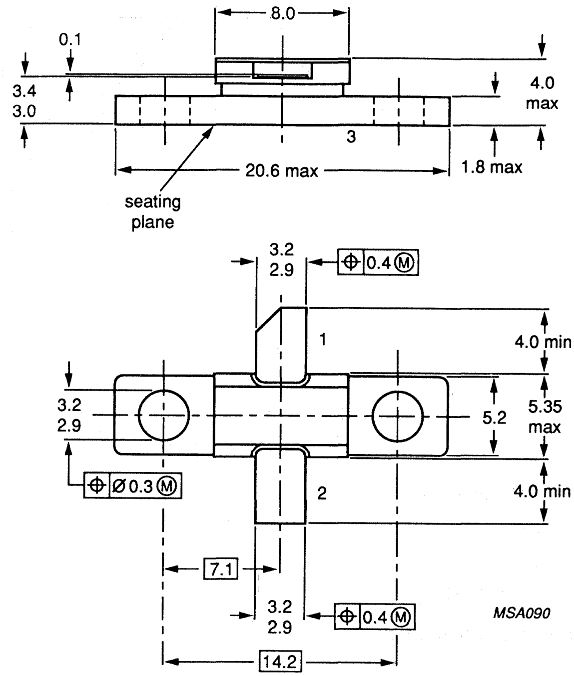
Fig. 1 FO-83.

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_{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.	1	A
Total power dissipation up to $T_{mb} = 75\ ^{o}C$	P_{tot}	max.	18	W
Storage temperature	T_{stg}		−65 to 200	^{o}C
Junction temperature	T_j	max.	200	^{o}C
Lead soldering temperature at 0.1 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	^{o}C

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

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

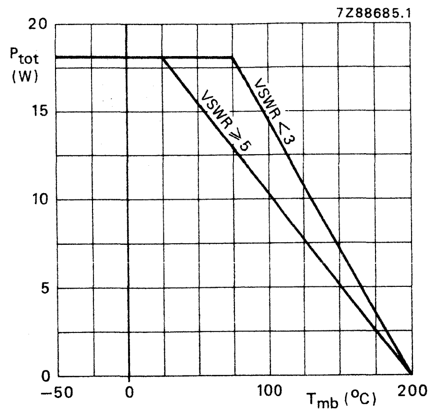


Fig. 2 Power derating curve as a function of mounting base temperature; V_{CE} = 24 V; f > 1 MHz.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector-emitter breakdown voltage I_C = 30 mA; R_{BE} = 10 Ω	$V_{(BR)CER}$	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	$\overline{z}_i$ Ω	$\overline{Z}_L$ Ω
1	2.3 + j2.8	7.8 + j11.6
2	1.4 + j9.5	3.9 + j2.6
3	4.2 + j21	2.3 − j2.5
4	38 − j32	1.9 − j8.5

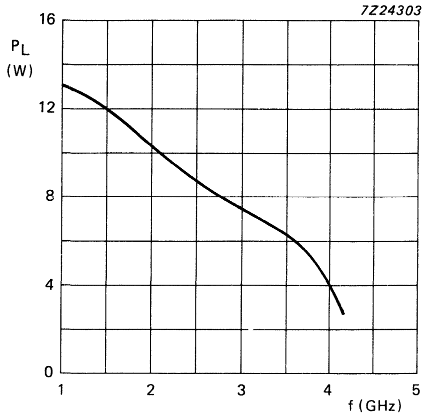


Fig. 3 Load power as a function of frequency. V_{CC} = 24 V; P_S = 1 W.

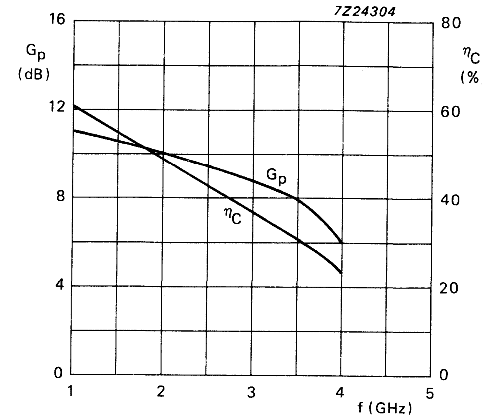


Fig. 4 Power gain and efficiency as a function of frequency. V_{CC} = 24 V; P_S = 1 W.

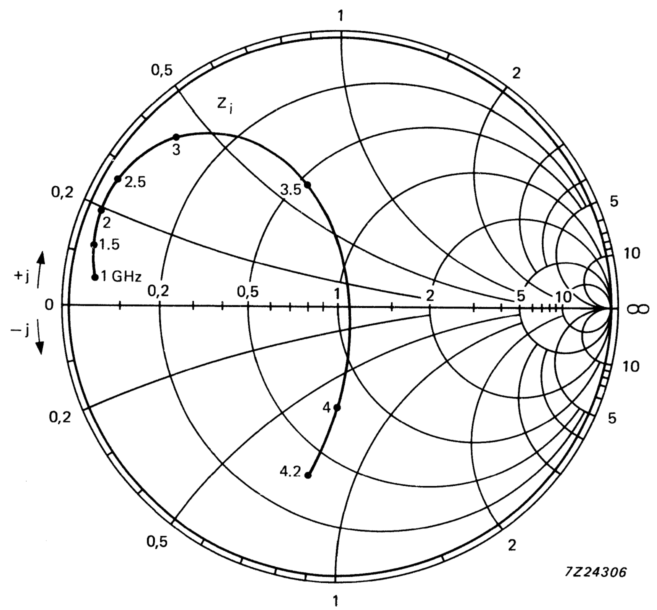


Fig. 5 Input impedance as a function of frequency. V_{CC} = 24 V; P_S = 1 W; Z_0 = 50 Ω.

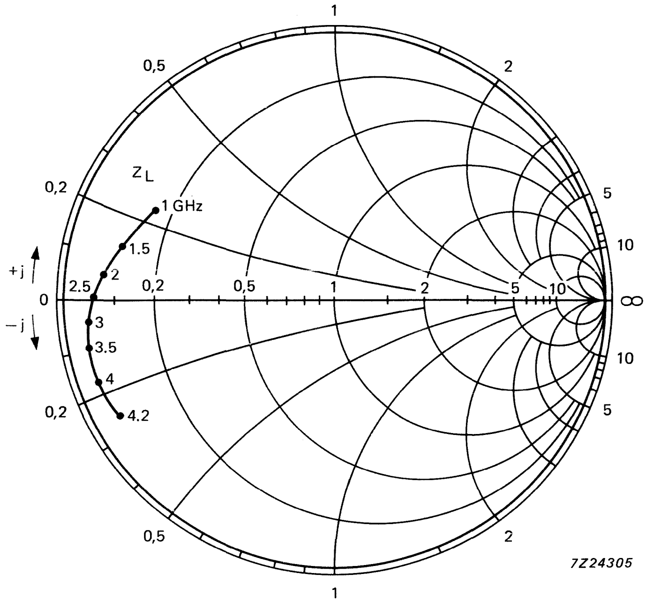


Fig. 6 Output impedance as a function of frequency.
V_{CC} = 24 V; P_S = 1 W; Z_0 = 50 Ω.

Philips 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 °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.**

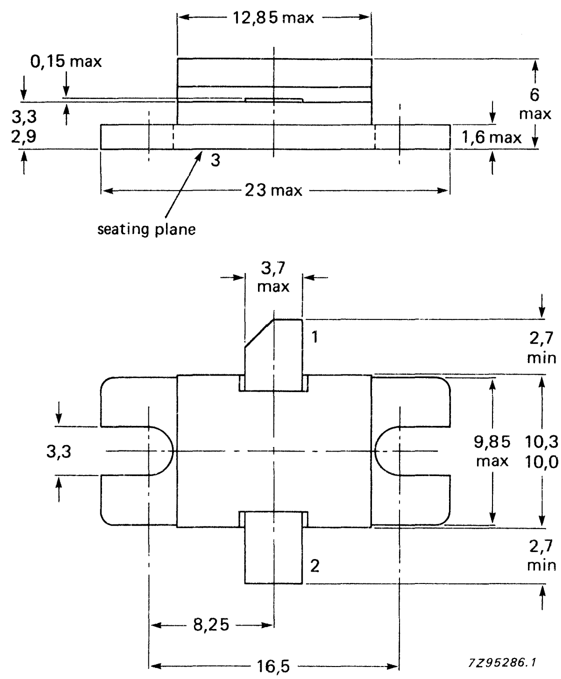
NPN silicon planar epitaxial microwave power transistor

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_{CBO}	collector-base voltage	open emitter	–	45	V
V_{CES}	collector-emitter voltage	$R_{BE} = 0\ \Omega$	–	45	V
V_{CEO}	collector-emitter voltage	open base	–	15	V
V_{EBO}	emitter-base voltage	open collector	–	3	V
I_C	collector current (DC)		–	6	A
P_{tot}	total power dissipation	$T_{mb} = 75$ °C	–	67	W
T_{stg}	storage temperature range		–65	200	°C
T_j	junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s up to 0.2 mm from ceramic	–	235	°C

THERMAL RESISTANCE

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	from junction to mounting base	$T_j = 100$ °C	1.5	K/W
$R_{th\ mb\text{-}h}$	from mounting base to heatsink		0.2	K/W

CHARACTERISTICS

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

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	$V_{CB} = 40$ V $I_E = 0$	3	mA
I_{CBO}	collector cut-off current	$V_{CB} = 45$ V $I_E = 0$	15	mA
I_{CES}	collector cut-off current	$V_{CE} = 30$ V $R_{BE} = 0\ \Omega$	3	mA
I_{EBO}	emitter cut-off current	$V_{EB} = 1.5$ V $I_C = 0$	300	µA

APPLICATION INFORMATION

Microwave performance up to $T_{mb} = 25$ °C measured in the common base test circuit as shown in Fig.2 and working in CW class C mode.

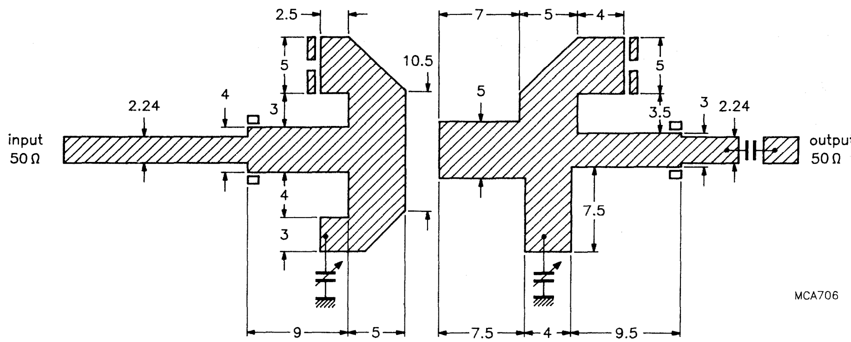
MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_c (%)	z_i / Z_L (Ω)
class C (CW) see note 1	1.65	28	≥ 45 typ. 50	≥ 8.5 typ. 9.5	≥ 45 typ. 52	see Figs 5 and 6

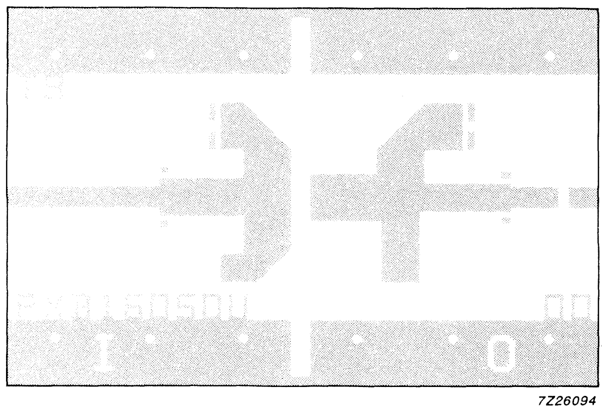
Note

Type PXB16050U may be used for narrowband or broadband amplifiers within the frequency range 1.5 to 1.8 GHz. Operation below 1.5 GHz may damage the transistor due to resonance of the internal output prematching circuit.

NPN silicon planar epitaxial microwave power transistor

PXB16050U





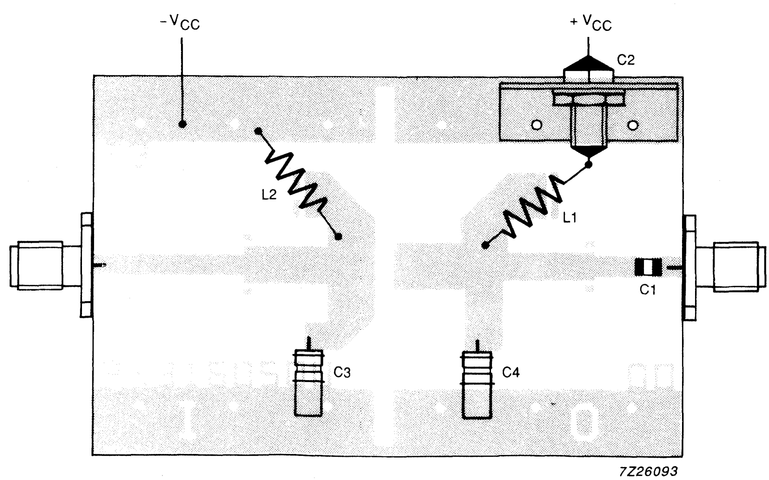


Fig.2 Narrowband test circuit, see note 1.

NPN silicon planar epitaxial microwave power transistor

PXB16050U

Note

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

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

   C1 DC blocking capacitor: 100 pF (ATC)

   C2 Feedthru bypass capacitor (Erie, 1250-003)

   C3, C4 Trimmer (Tekelec, AT-3-7271SL, 0.6 - 4.5 pF)

   L1 Cu wire ∅ = 0.5 mm; ∅ internal = 2 mm, 4 turns
   L2 Cu wire ∅ = 0.5 mm; ∅ internal = 2 mm, 5 turns

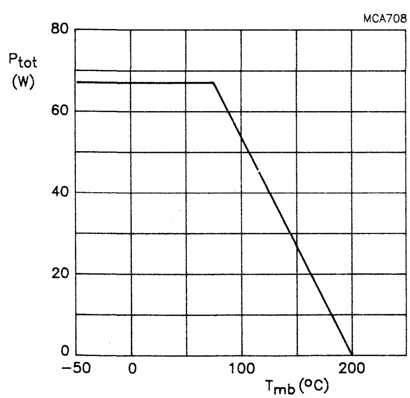


Fig.3 Maximum power dissipation as a function of mounting base temperature; P_{tot} max = 67 W.

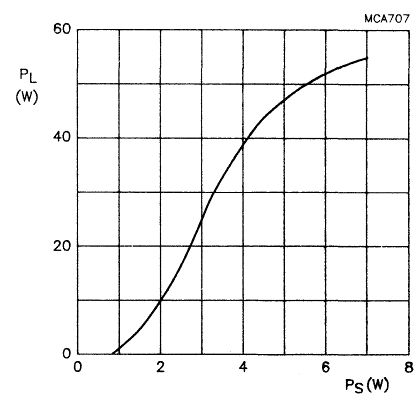


Fig.4 Load power P_L as a function of source power P_S; V_C = 28 V; f = 1.65 GHz.
See narrowband test circuit as shown in Fig.2.

NPN silicon planar epitaxial microwave power transistor

PXB16050U

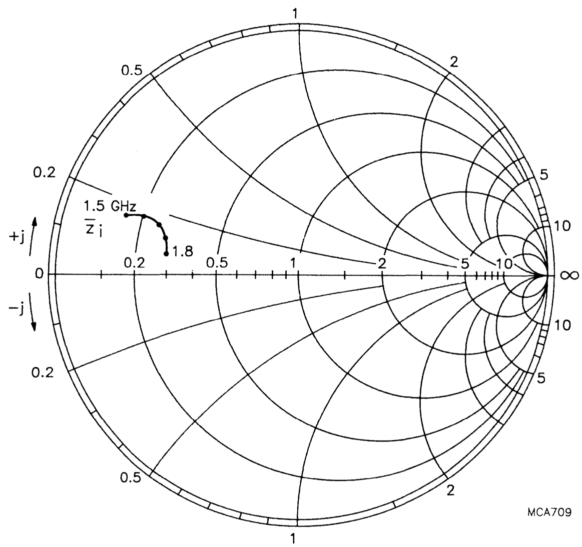


Fig.5 Input impedance as a function of frequency; $Z_o = 10\ \Omega$; $V_{CC} = 28$ V; typical values.

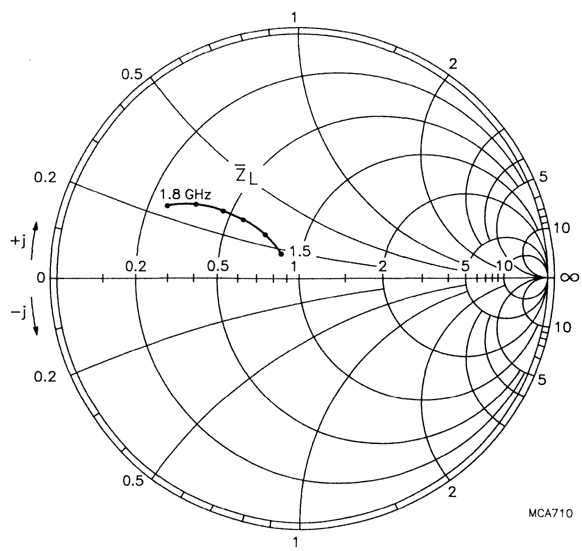


Fig.6 Optimum load impedance as a function of frequency; $Z_o = 10\ \Omega$; $V_{CC} = 28$ V; typical values.

MICROWAVE POWER TRANSISTORS FOR BROADBAND AMPLIFIERS

NPN transistors for use in common-base, class-B, wideband amplifiers under CW conditions in military and professional applications and intended to drive PZ1418B30U/PZ1721B25U/PZ2024B20U family.

Features

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistors providing excellent current sharing and withstanding a high VSWR
- Gold metallization realizing a very good stability of the characteristics and an excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- 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 °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

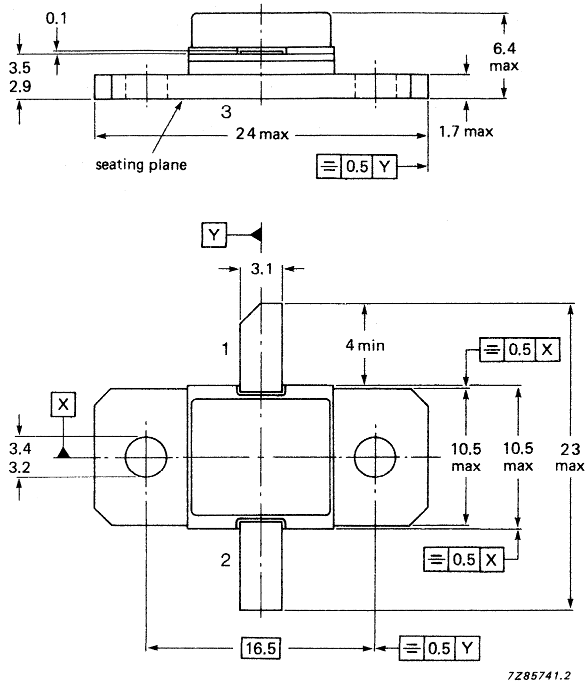
Product and environmental safety — toxic materials

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

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
open base	V_{CEO}	max.	15 V
Emitter-base voltage			
open collector	V_{EBO}	max.	3 V
Collector current (DC)	I_C	max.	2 A
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	27 W
Storage temperature	T_{stg}	−65 to	+ 200 °C
Junction temperature	T_j	max.	+ 200 °C
Lead soldering temperature	T_{sld}	max.	+ 235 °C

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	4 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2 K/W

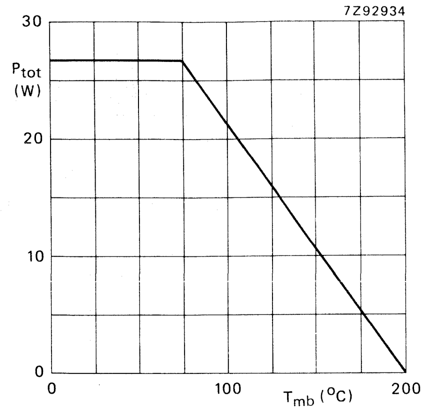


Fig. 2 Power derating curve as a function of mounting base temperature.

CHARACTERISTICS

$T_{mb} = 25\ ^oC$

Collector cut-off current				
$I_E = 0$; $V_{CB} = 30$ V	I_{CBO}	max.	2.5	mA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	max.	5	mA
$R_{BE} = 10\ \Omega$; $V_{CE} = 35$ V	I_{CER}	max.	25	mA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	100	μA
$I_C = 0$; $V_{EB} = 3$ V	I_{EBO}	max.	0.5	mA

APPLICATION INFORMATION (type PZ1418B15U)

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

type number	f GHz	V_{CC} V	P_L W	G_P dB	η_C %	z_i Ω	Z_L Ω
PZ1418B15U	1.4 to 1.8	28	⩾ 12.5 typ. 15	⩾ 7 typ. 7.8	⩾ 38 typ. 45	see Fig.6	see Fig.7

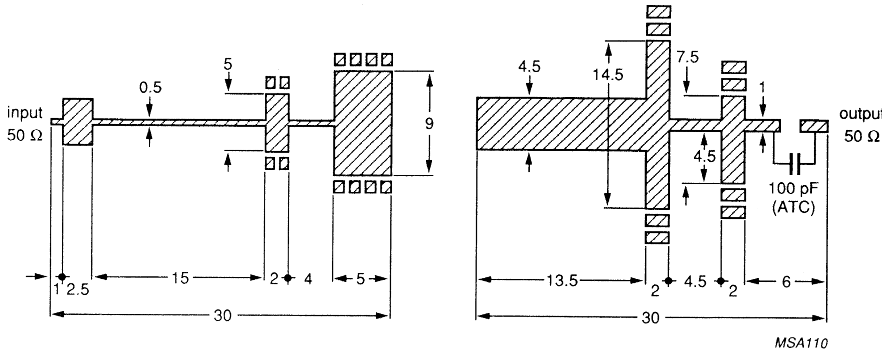


Fig. 3 Wideband test circuit boards for 1.4 to 1.8 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; ϵ_r = 10.

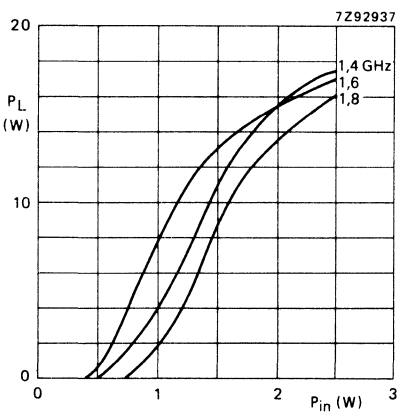


Fig. 4 Load power as a function of input power; typical values.

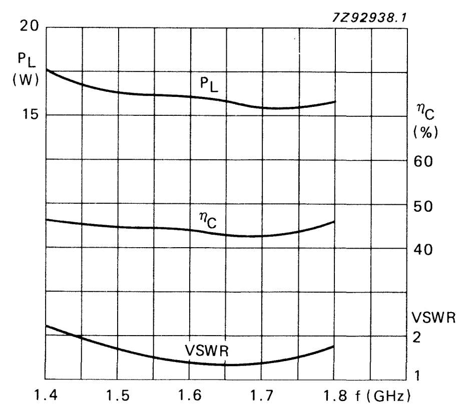


Fig. 5 Load power, efficiency and VSWR as a function of frequency; typical values; P_{in} = 2.5 W.

Conditions for Figs 4 and 5:

V_{CC} = 28 V; class-B operation; T_{mb} = 25 °C.

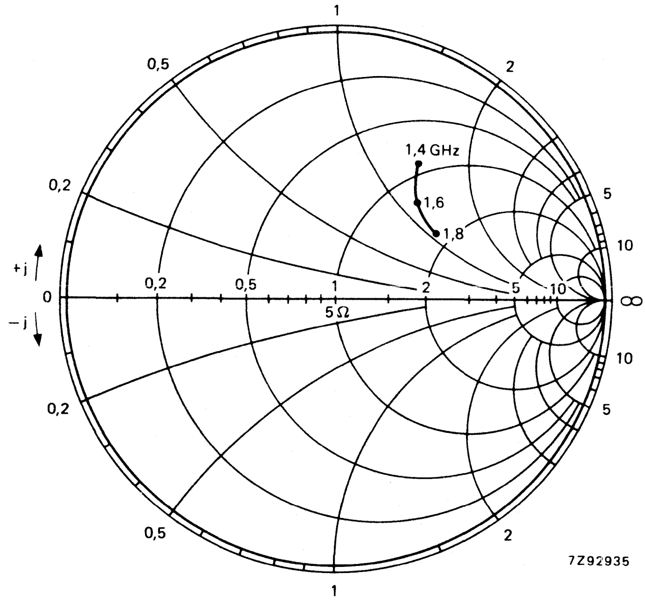


Fig. 6 Input impedance as a function of frequency; typical values; $Z_O = 5\ \Omega$.

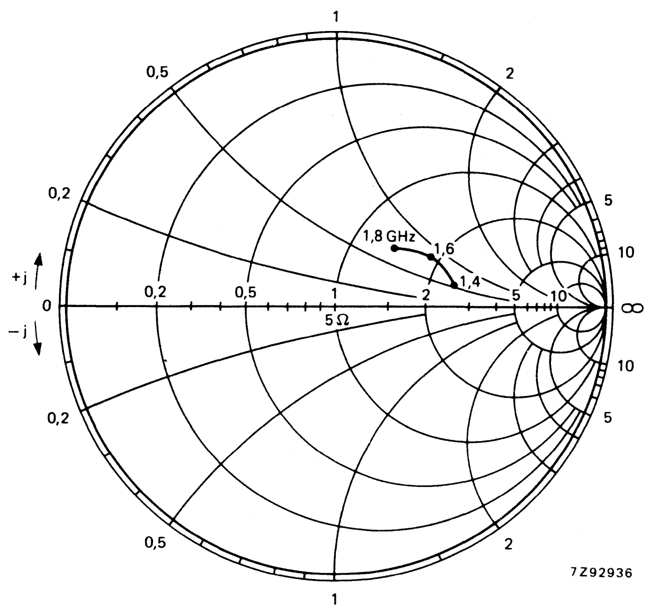


Fig. 7 Optimum load impedance as a function of frequency; typical values; $Z_O = 5\ \Omega$.

APPLICATION INFORMATION (type PZ1721B12U)

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

type number	f GHz	V_{CC} V	P_L W	G_P dB	η_C %	z_i Ω	Z_L Ω
→ PZ1721B12U	1.7 to 2.1	28	≥ 12 typ. 16	≥ 6.8 typ. 8	≥ 35 typ. 45	see Fig.11	see Fig.12

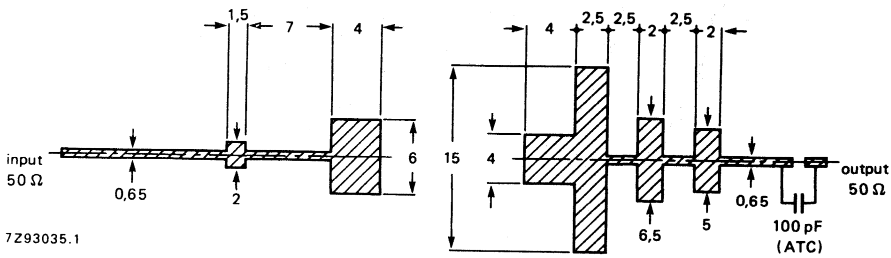


Fig. 8 Wideband test circuit boards for 1.7 to 2.1 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; ϵ_r = 10.

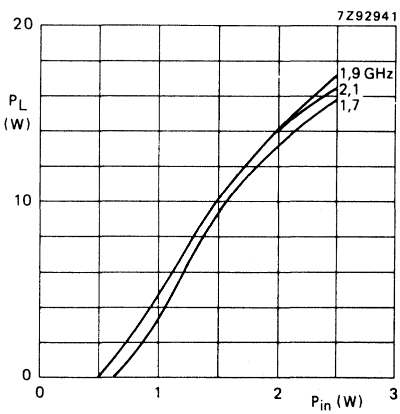


Fig. 9 Load power as a function of input power; typical values.

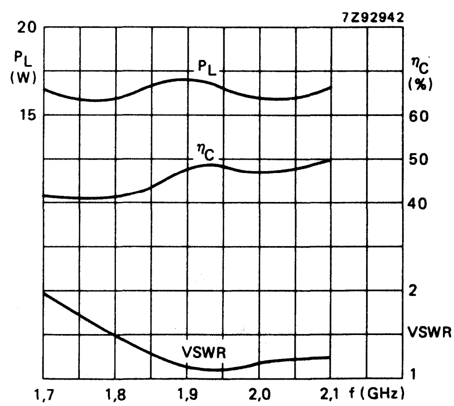


Fig. 10 Load power, efficiency and VSWR as a function of frequency; typical values; P_{in} = 2.5 W.

Conditions for Figs 9 and 10:

V_{CC} = 28 V; class-B operation; T_{mb} = 25 °C.

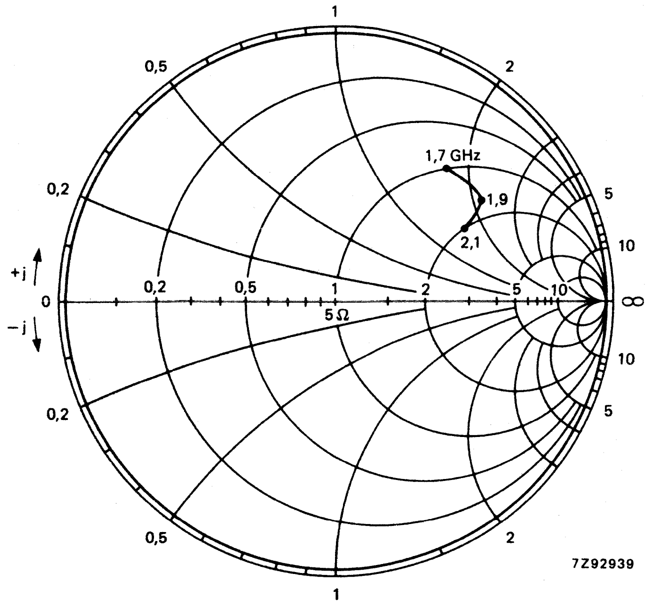


Fig. 11 Input impedance as a function of frequency; typical values; $Z_O = 5\ \Omega$.

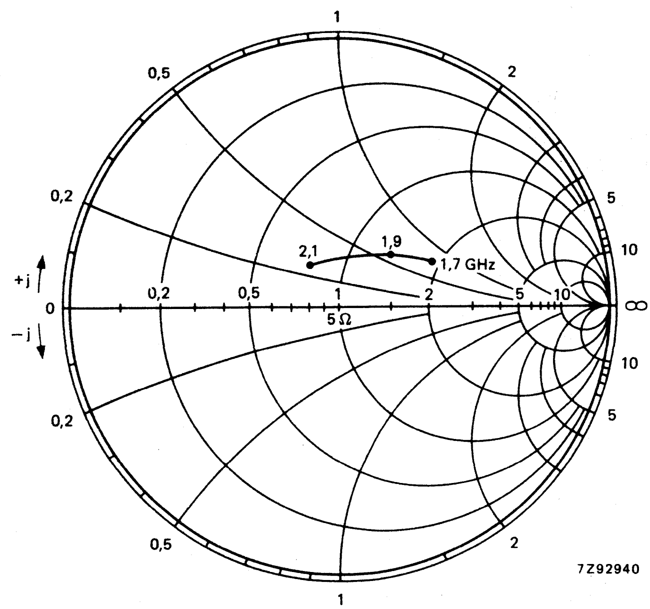


Fig. 12 Optimum load impedance as a function of frequency; typical values; $Z_O = 5\ \Omega$.

APPLICATION INFORMATION (type PZ2024B10U)

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

type number	f GHz	V_{CC} V	P_L W	G_P dB	η_C %	z_i Ω	Z_L Ω
PZ2024B10U	2.0 to 2.4	28	⩾ 9 typ. 12	⩾ 5.6 typ. 6.8	⩾ 30 typ. 45	see Fig.16	see Fig.17

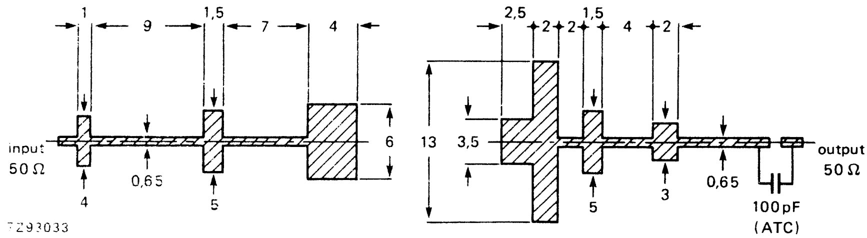


Fig. 13 Wideband test circuit boards for 2.0 to 2.4 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; ϵ_r = 10.

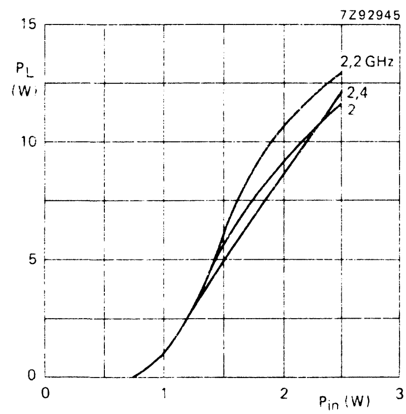


Fig. 14 Load power as a function of input power; typical values.

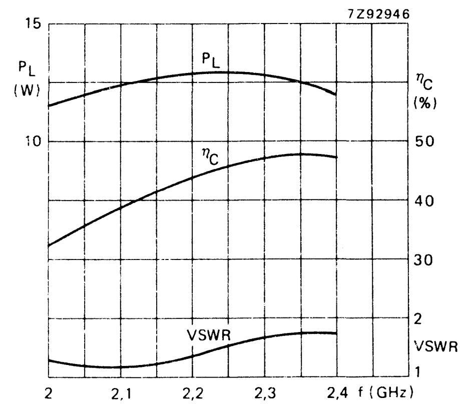


Fig. 15 Load power, efficiency and VSWR as a function of frequency; typical values; P_{in} = 2.5 W.

Conditions for Figs 14 and 15:

V_{CC} = 28 V; class-B operation; T_{mb} = 25 °C.

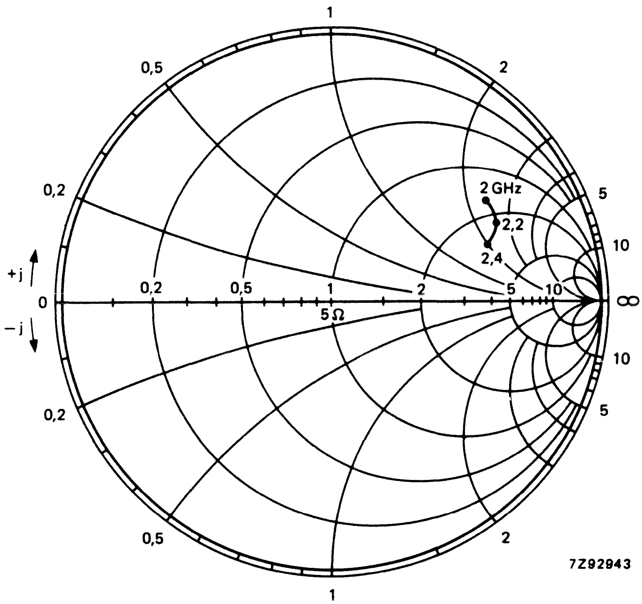


Fig. 16 Input impedance as a function of frequency; typical values; Z_O = 5 Ω.

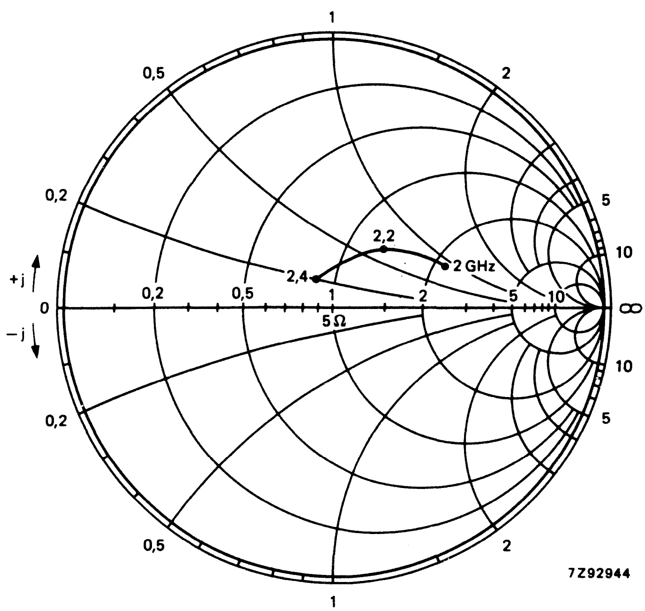


Fig. 17 Optimum load impedance as a function of frequency; typical values; Z_O = 5 Ω.

MICROWAVE POWER TRANSISTORS FOR WIDEBAND AMPLIFIERS

NPN transistors for use in common-base, class-B, broadband amplifiers under CW conditions in military and professional applications.

Features

- Interdigitated structure giving a high emitter efficiency
- Diffused emitter ballasting resistors providing excellent current sharing and withstanding a high VSWR
- Gold metallization realising a very good stability of the characteristics and an excellent life-time
- Multicell geometry giving good balance of dissipated power and low thermal resistance
- 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 °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

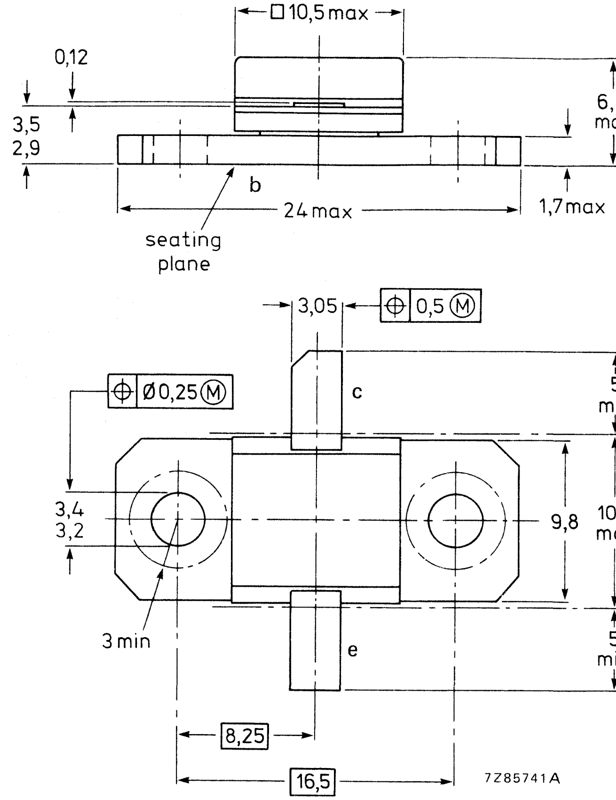
Product and environmental safety — toxic materials

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 Ω	V_{CER}	max.	35 V
open base	V_{CEO}	max.	15 V
Emitter-base voltage open collector	V_{EBO}	max.	3 V
Collector current (DC)	I_C	max.	4 A
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	45 W
Storage temperature	T_{stg}	−65 to	+ 200 °C
Junction temperature	T_j	max.	+ 200 °C
Lead soldering temperature	T_{sld}	max.	+ 235 °C

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	2.2 K/W
→ From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2 K/W

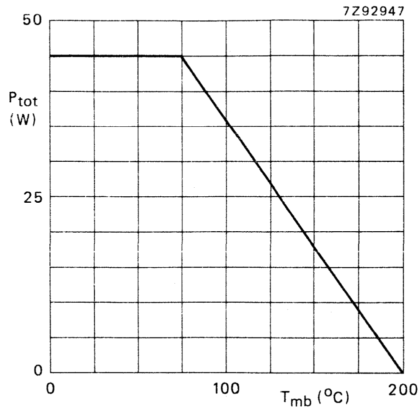


Fig.2 Power derating curve as a function of mounting base temperature.

CHARACTERISTICS

T_{mb} = 25 °C

Collector cut-off current				
$I_E = 0$; $V_{CB} = 30$ V	I_{CBO}	max.	5	mA
$I_E = 0$; $V_{CB} = 40$ V	I_{CBO}	max.	10	mA
$R_{BE} = 10\ \Omega$; $V_{CE} = 35$ V	I_{CER}	max.	50	mA
Emitter cut-off current				
$I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	200	μA
$I_C = 0$; $V_{EB} = 3$ V	I_{EBO}	max.	1	mA

APPLICATION INFORMATION (type PZ1418B30U)

Microwave performance up to T_{mb} = 25 °C in an unneutralized common-base class-B wideband amplifier.

type number	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
→ PZ1418B30U	1.4 to 1.8	28	⩾ 27 typ. 35	⩾ 7.3 typ. 8.4	⩾ 38 typ. 45	see Fig.6	see Fig.7

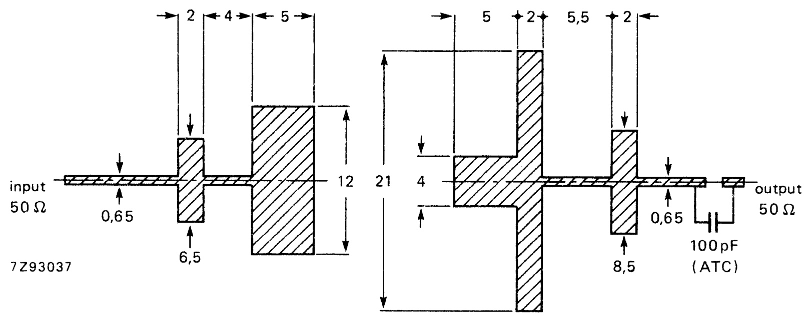


Fig. 3 Wideband test circuit boards for 1.4 to 1.8 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; ϵ_r = 10.

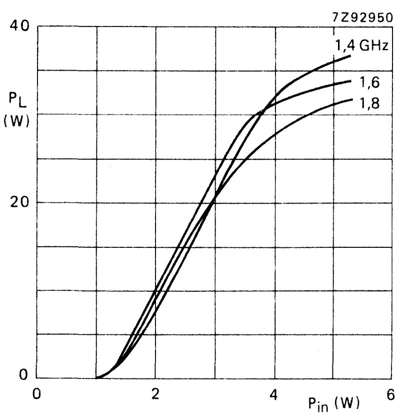


Fig. 4 Load power as a function of input power; typical values.

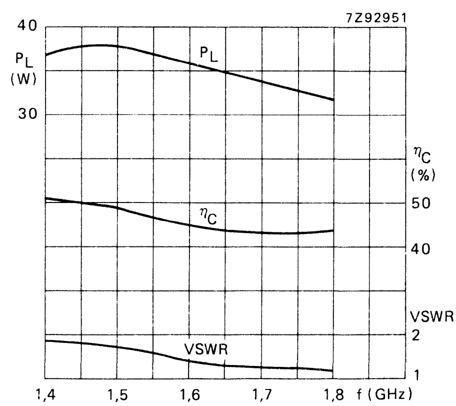


Fig.5 Load power, efficiency and VSWR as a function of frequency; typical values; P_{in} = 5 W.

Conditions for Figs 4 and 5:

V_{CC} = 28 V; class-B operation; T_{mb} = 25 °C.

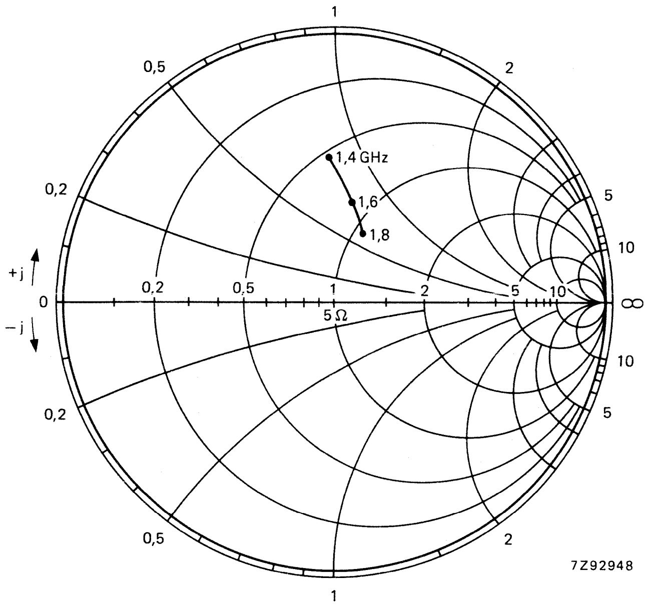


Fig. 6 Input impedance as a function of frequency; typical values; $Z_O = 5\ \Omega$.

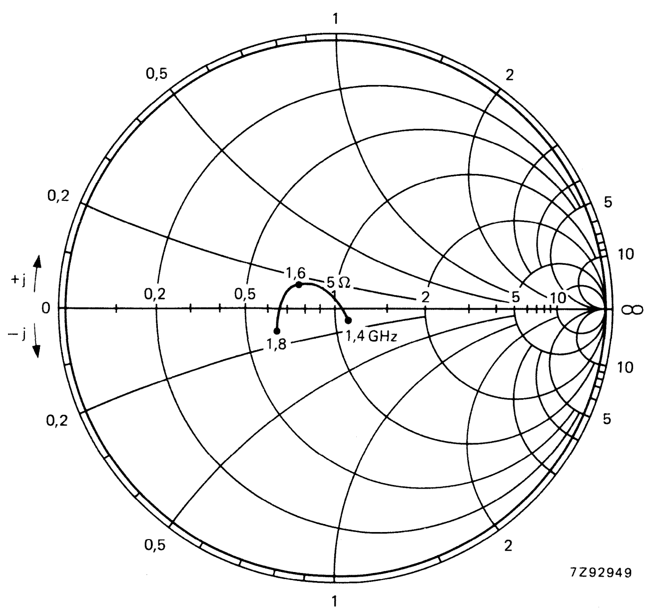


Fig. 7 Optimum load impedance as a function of frequency; typical values; $Z_O = 5\ \Omega$.

APPLICATION INFORMATION (type PZ1721B25U)

Microwave performance up to T_{mb} = 25 °C in an unneutralized common-base class-B wideband amplifier.

type number	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
PZ1721B25U	1.7 to 2.1	28	⩾ 25 typ. 30	⩾ 7 typ. 7.8	⩾ 35 typ. 44	see Fig.11	see Fig.12

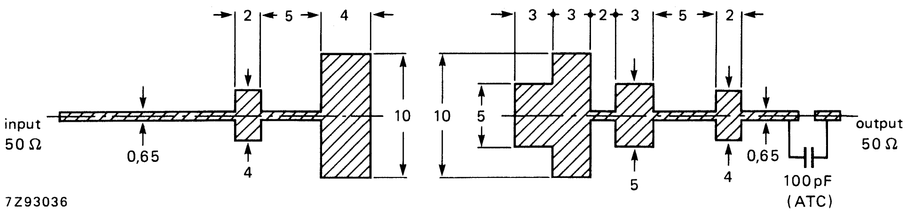


Fig. 8 Wideband test circuit boards for 1.7 to 2.1 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; ϵ_r = 10.

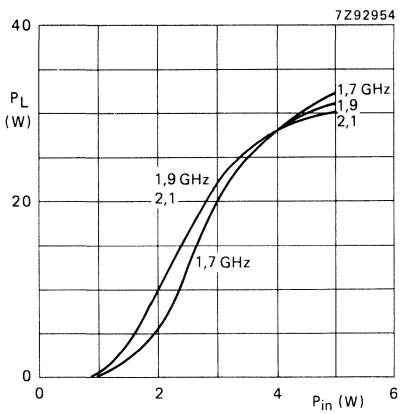


Fig. 9 Load power as a function of input power; typical values.

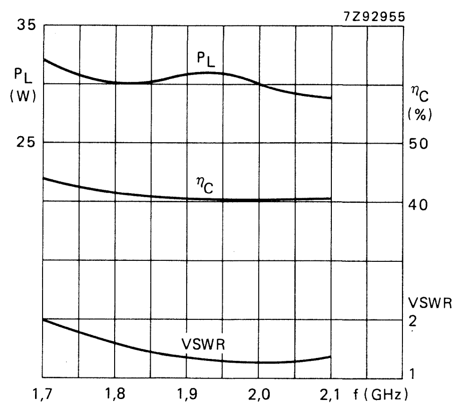


Fig. 10 Load power, efficiency and VSWR as a function of frequency; typical values; P_{in} = 5 W.

Conditions for Figs 9 and 10:

V_{CC} = 28 V; class-B operation; T_{mb} = 25 °C.

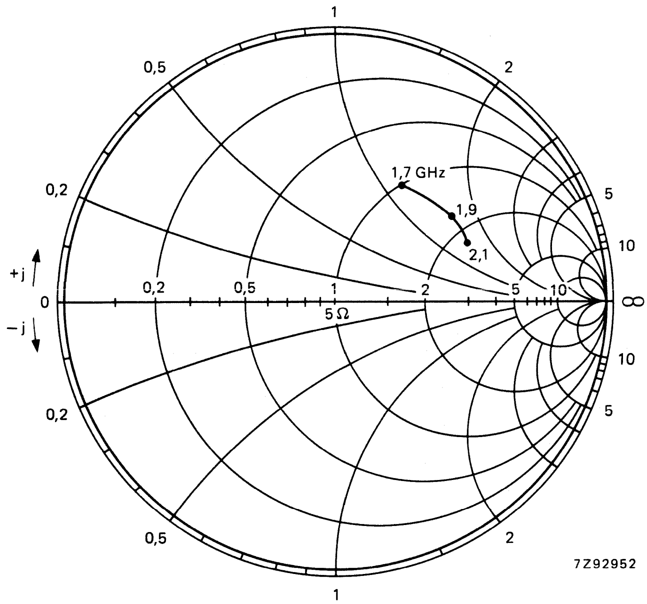


Fig. 11 Input impedance as a function of frequency; typical values; Z_O = 5 Ω.

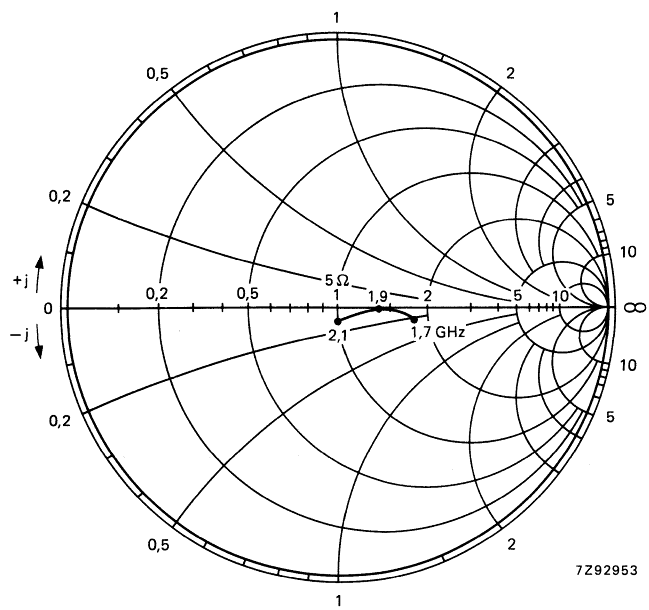


Fig. 12 Optimum load impedance as a function of frequency; typical values; Z_O = 5 Ω.

APPLICATION INFORMATION (type PZ2024B20U)

Microwave performance up to T_{mb} = 25 °C in an unneutralized common-base class-B wideband amplifier.

type number	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
PZ2024B20U	2.0 to 2.4	28	≥ 20 typ. 26	≥ 6 typ. 7	≥ 35 typ. 42	see Fig.16	see Fig.17

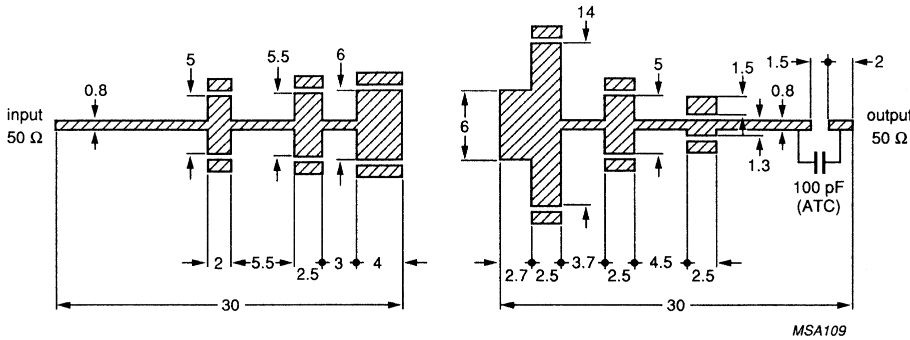


Fig. 13 Wideband test circuit boards for 2.0 to 2.4 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.635 mm; ϵ_r = 10.

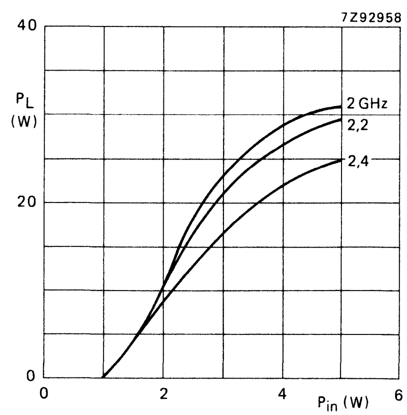


Fig. 14 Load power as a function of input power; typical values.

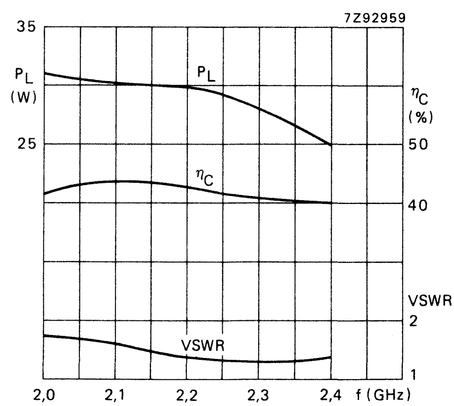


Fig. 15 Load power, efficiency and VSWR as a function of frequency; typical values; P_{in} = 5 W.

Conditions for Figs 14 and 15:

V_{CC} = 28 V; class-B operation; T_{mb} = 25 °C.

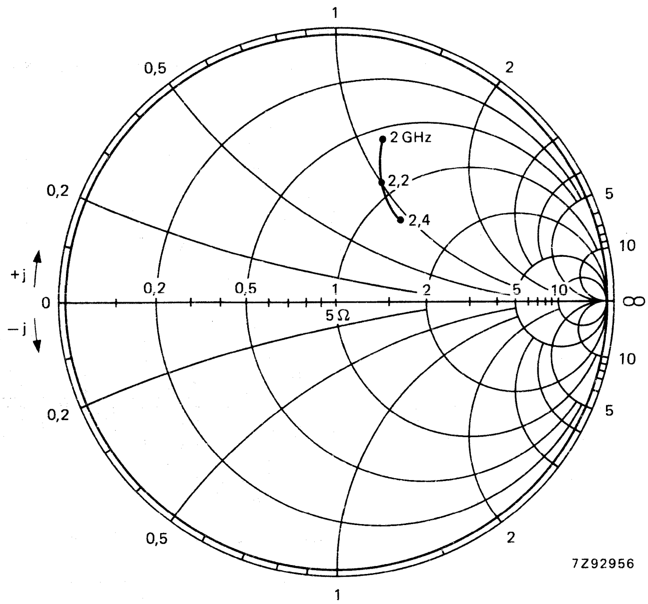


Fig. 16 Input impedance as a function of frequency; typical values; $Z_O = 5\ \Omega$.

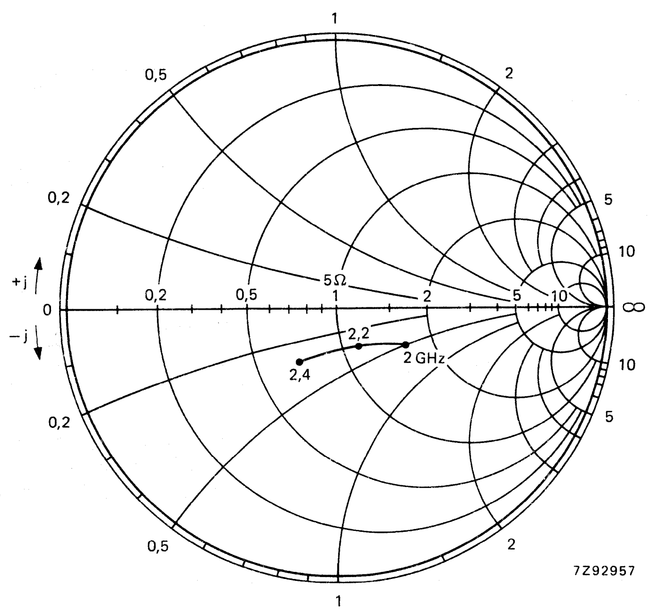


Fig. 17 Optimum load impedance as a function of frequency; typical values; $Z_O = 5\ \Omega$.

MICROWAVE POWER TRANSISTOR

NPN silicon epitaxial microwave power transistor, intended for use in a common-base, class-C 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 ^{o}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.

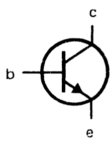
After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general industrial or domestic waste.

MECHANICAL DATA

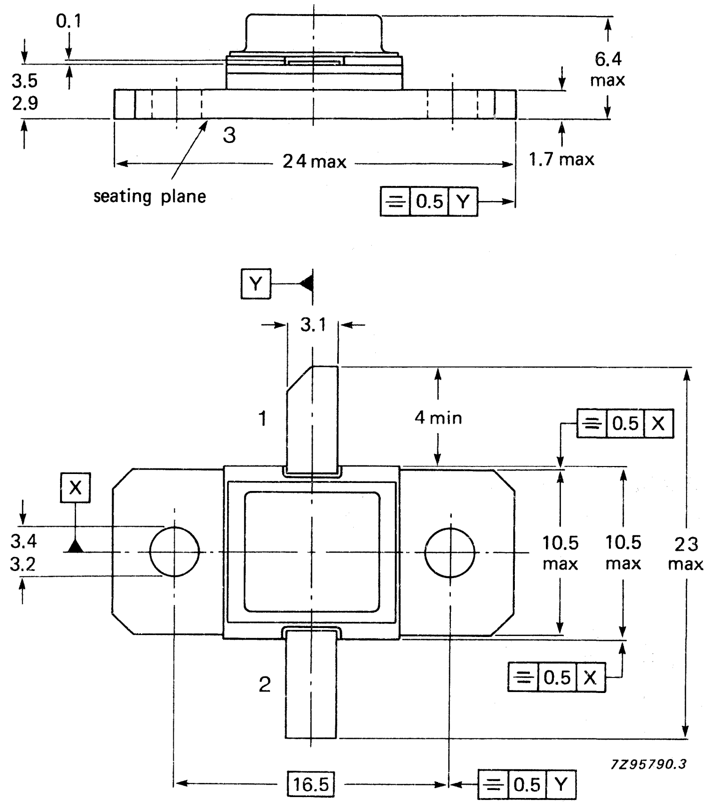
Dimensions in mm

Fig. 1 FO-57D.

Pinning
1 = collector
2 = emitter
3 = base



Base is connected to the seating plane



RATINGS

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

Collector-base voltage; open emitter	V_{CBO}	max.	40	V
Collector-emitter voltage; R_{BE} = 10 Ω	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 $T_{mb} \leq 75$ °C	P_{tot}	max.	32	W
Storage temperature range	T_{stg}		−65 to + 200	°C
Operating junction temperature	T_j	max.	200	°C
→ Soldering temperature at 0.2 mm from the case; $t_{sld} \leq 10$ s	T_{sld}	max.	235	°C

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	4	K/W
→ From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2	K/W

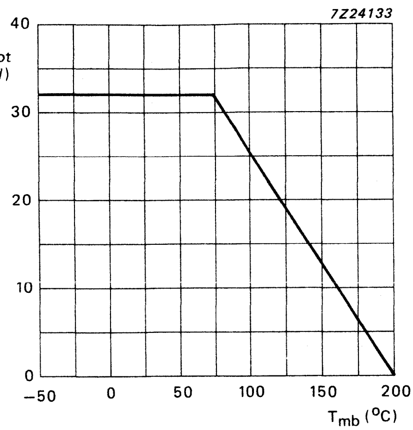


Fig. 2 Power derating curve.

DEVELOPMENT DATA

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off current

V_{CB} = 40 V; I_E = 0	I_{CBO}	max.	8 mA
V_{CB} = 30 V; I_E = 0	I_{CBO}	max.	80 μA
V_{CE} = 30 V; R_{BE} = 10 Ω	I_{CER}	max.	130 μA
V_{CE} = 40 V; I_B = 0	I_{CEO}	max.	1 mA

Emitter cut-off current

V_{EB} = 1.5 V; I_C = 0	I_{EBO}	max.	100 μA
V_{EB} = 3.5 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 Ω
class-C; CW	2.3 to 2.7	28	⩾ 15 typ. 16	⩾ 7 typ. 8	⩾ 40 typ. 45	see Figs 6 and 7

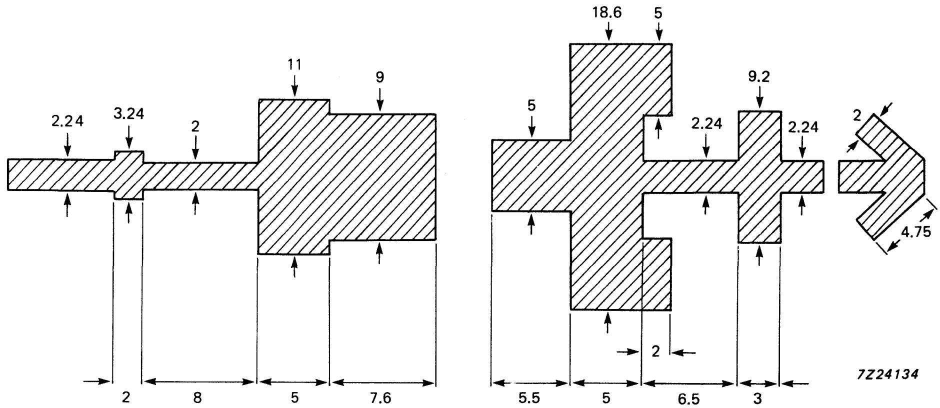


Fig. 3 Broadband test circuit for 2.3 to 2.7 GHz; class-C; CW application
Teflon fibreglass; ϵ_r = 2.55; thickness 0.8 mm (dimensions in mm).

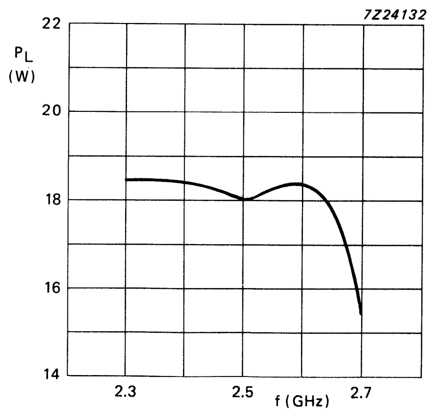


Fig. 4 Load power as a function of frequency;
P_{in} = 2.5 W; typical values.

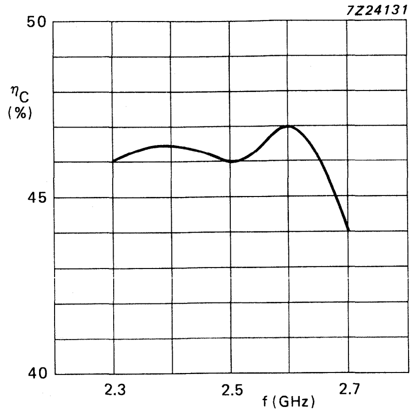


Fig. 5 Power gain as a function of frequency; typical values.

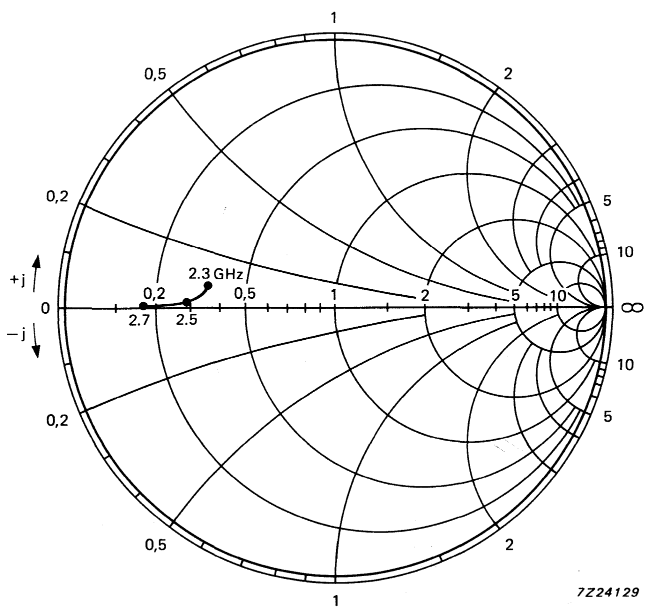


Fig. 6 Input impedance as a function of frequency;
V_{CC} = 28 V; P_L = 16 W; Z_O = 50 Ω.

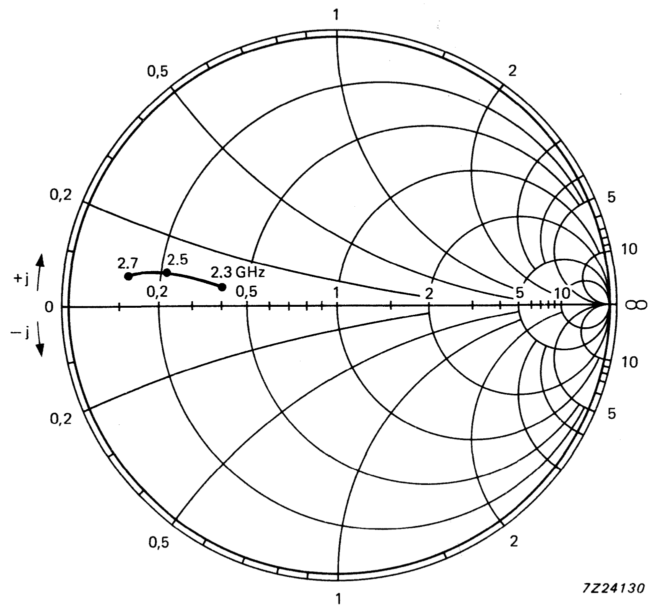


Fig. 7 Optimum load impedance as a function of frequency; V_{CC} = 28 V; P_L = 16 W; Z_O = 50 Ω.

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 °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

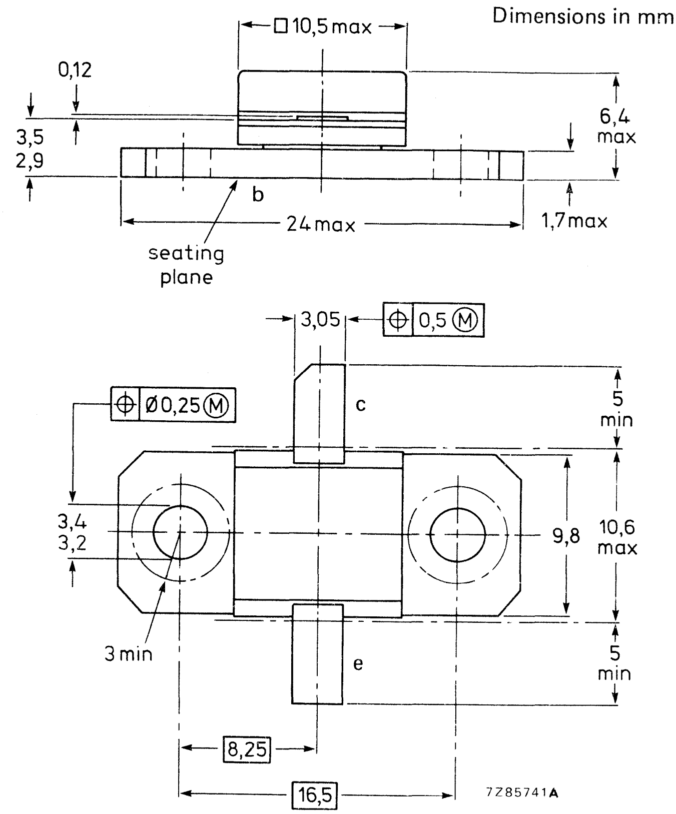
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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 Ω	V_{CER}	max.	35 V
open base	V_{CEO}	max.	15 V
Emitter-base voltage open collector	V_{EBO}	max.	3 V
Collector current (DC)	I_C	max.	4 A
Total power dissipation up to T_{mb} = 75 °C	P_{tot}	max.	45 W
Storage temperature	T_{stg}	−65 to	+ 200 °C
Junction temperature	T_j	max.	+ 200 °C
→ Lead soldering temperature > 0.2 mm from flange; t_{sld} < 10 s	T_{sld}	max.	+ 235 °C

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	2.2 K/W
→ From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2 K/W

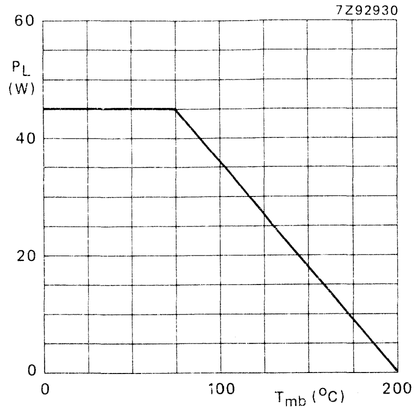


Fig.2 Power derating curve as a function of mounting base temperature.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off currents				
V_{CB} = 40 V; I_E = 0	I_{CBO}	max.	10	mA
V_{CB} = 30 V; I_E = 0	I_{CBO}	max.	5	mA
V_{CER} = 35 V; R_{BE} = 10 Ω	I_{CER}	max.	50	mA
Emitter cut-off currents				
V_{EB} = 3 V; I_C = 0	I_{EBO}	max.	1	mA
V_{EB} = 1.5 V; I_C = 0	I_{EBO}	max.	200	μA
Collector-base capacitance				
I_E = I_C = 0; V_{CB} = 28 V	C_{cb}	typ.	17	pF

APPLICATION INFORMATION

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

mode of operation	f GHz	V_{CC} V	P_L W	G_P dB	η_C %	z_i Ω	Z_L Ω
C.W. class-B	1,55	28	> 35 typ. 38	> 8 typ. 9.8	> 45 typ. 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.

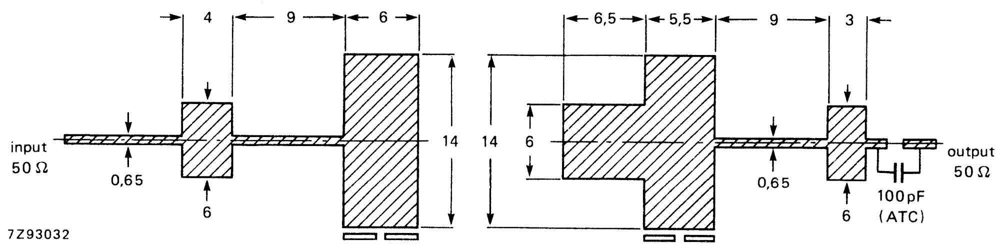


Fig. 3 Prematching test circuit boards, CW, class-B at 1.55 GHz (dimensions in mm); Epsilam p.c. board; thickness 0.65 mm; ϵ_r = 10.

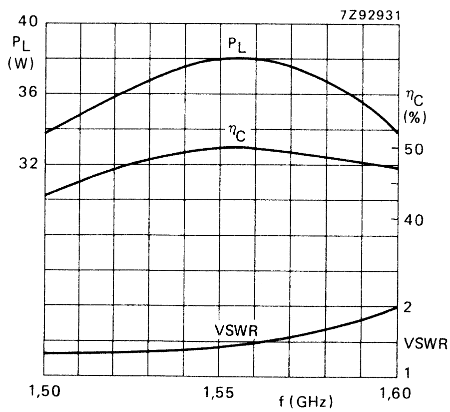


Fig. 4 Load power, efficiency and VSWR as a function of frequency; V_{CE} = 28 V; T_{mb} = 25 °C; class-B operation; typical values.

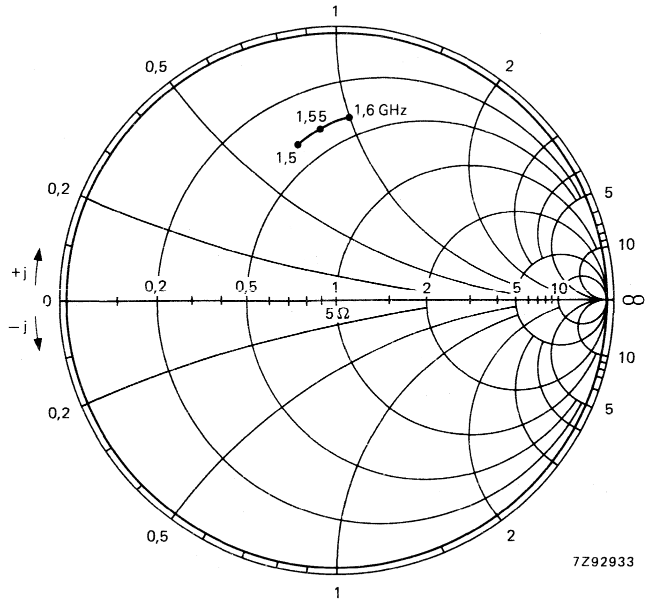


Fig. 5 Input impedance as a function of frequency;
P_L = 38 W; Z_O = 5 Ω; typical values.

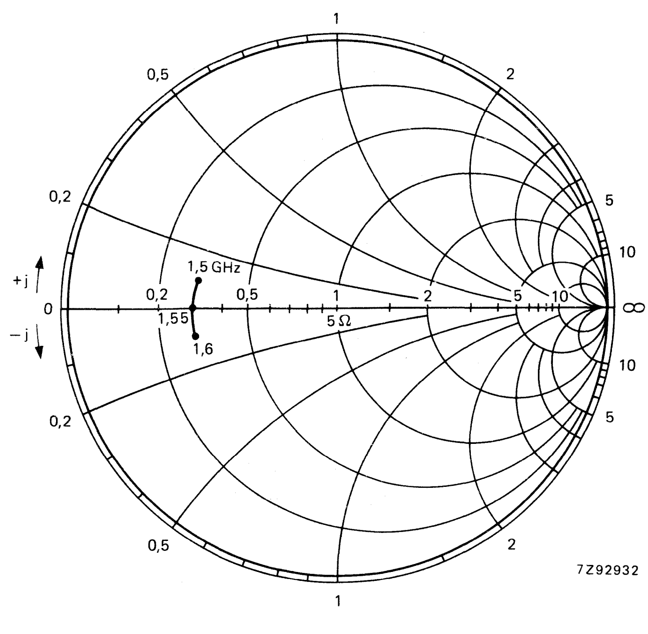


Fig. 6 Optimum load impedance as a function of frequency;
P_L = 38 W; Z_O = 5 Ω; typical values.

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 °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.

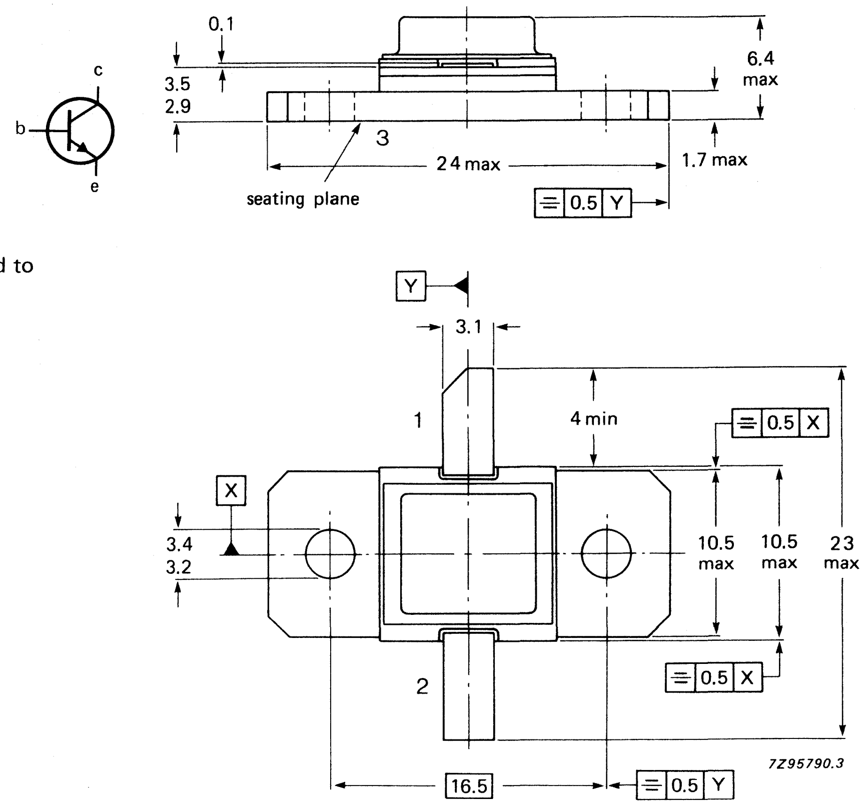
MECHANICAL DATA

Dimensions in mm

Fig. 1 FO-57D.

Pinning
1 = collector
2 = emitter
3 = base

Base is connected to the seating plane



RATINGS

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

Collector-base voltage; open emitter	V_{CBO}	max.	40 V
Collector-emitter voltage; R_{BE} = 10 Ω	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 $T_{mb} \leq 75$ °C	P_{tot}	max.	67.5 W
Storage temperature range	T_{stg}		−65 to 200 °C
Operating junction temperature	T_j	max.	200 °C
Soldering temperature at 0.3 mm from the case; $t_{sld} \leq 10$ s	T_{sld}	max.	235 °C

THERMAL RESISTANCE (at T_j = 200 °C)

From junction to mounting base	$R_{th\,j\text{-}mb}$	max.	2.5 K/W

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 °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

Dimensions in mm

FO-57C (see Fig. 1)

WARNING

Product and environmental safety — toxic materials

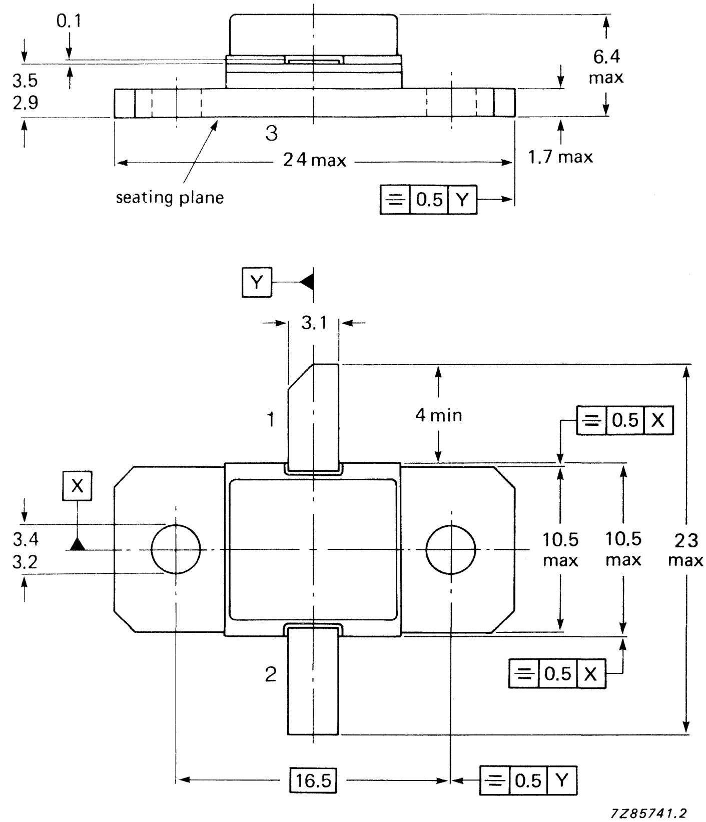
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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

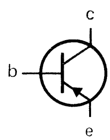
Dimensions in mm

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.	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 $T_{mb} = 75\ ^oC$	P_{tot}	max.	67.5	W
Storage temperature	T_{stg}	−65 to + 200		^oC
Junction temperature	T_j	max.	200	^oC
Soldering temperature at 0.1 mm from case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	^oC

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 °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

Dimensions in mm

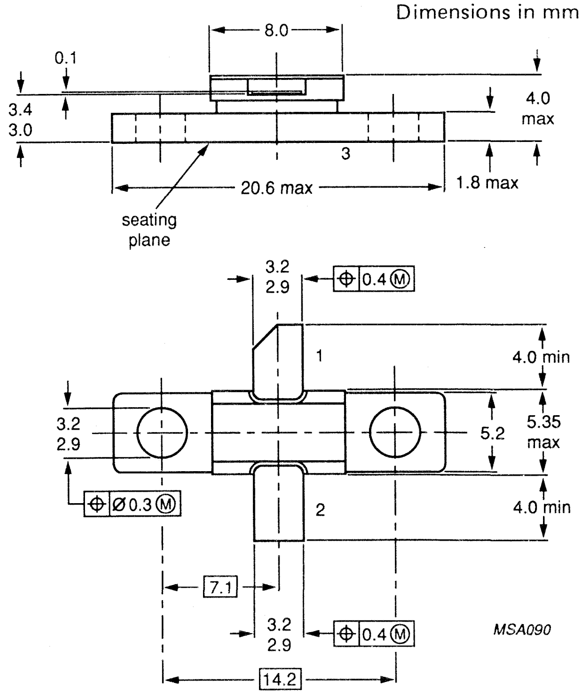
Fig. 1 FO-83.

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)	V_{CES}	max.	35 V
(open base)	V_{CEO}	max.	15 V
Emitter-base voltage (open collector)	V_{EBO}	max.	3 V
Collector current (DC) (t_p = 100 μs; δ = 10%)	I_C	max.	1 A
Total power dissipation up to T_{mb} = 75 °C (t_p = 100 μs; δ = 10%)	P_{tot}	max.	25 W
Storage temperature range	T_{stg}		−65 to +200 °C
Junction temperature	T_j	max.	200 °C
Lead soldering temperature at 0.3 mm from the case $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 °C

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	6.5 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.6 K/W

CHARACTERISTICS

T_{mb} = 25 °C

Collector-base breakdown voltage I_C = 3 mA; open emitter	$V_{(BR)CBO}$	min.	35 V
Collector-emitter breakdown voltage R_{BE} = 0; I_C = 3 mA	$V_{(BR)CES}$	min.	35 V
Emitter-base breakdown voltage I_E = 0.5 mA; open collector	$V_{(BR)EBO}$	min.	3 V
Collector cut-off current I_E = 0; V_{CB} = 24 V	I_{CBO}	max.	0.1 mA
Emitter cut-off current I_C = 0; V_{EB} = 1.5 V	I_{EBO}	max.	10 μA

APPLICATION INFORMATION

RF performance up to T_{mb} = 25 °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

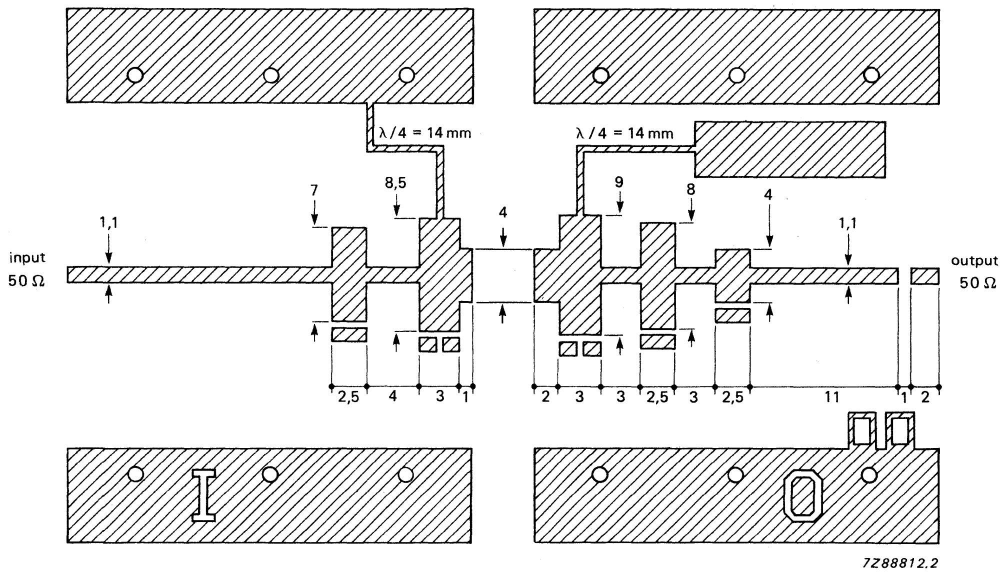


Fig. 2 Wideband test circuit boards for 3.1 to 3.5 GHz (dimensions in mm); striplines on a double CU-clad p.c. board with PTFE fibre-glass dielelctric (ϵ_r = 2,54); thickness 0.4 mm.

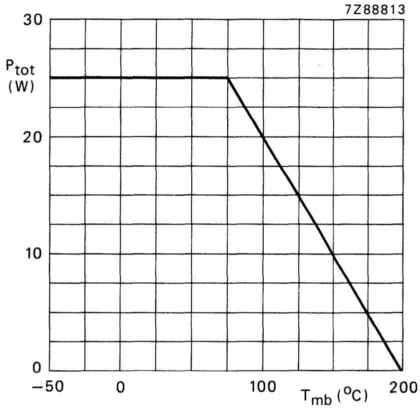


Fig. 3

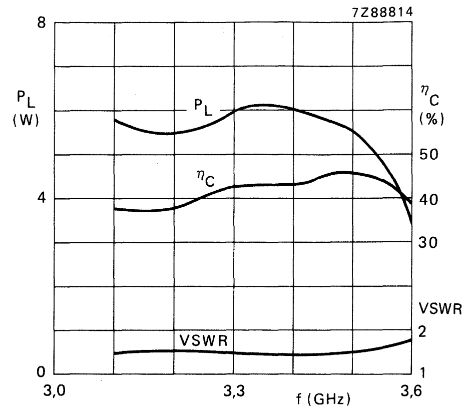


Fig. 4.

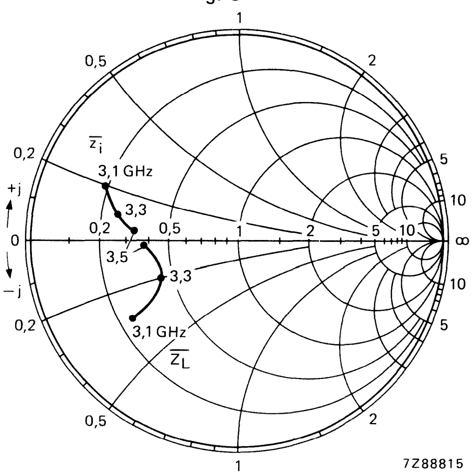


Fig. 5.

Fig. 3 Power derating curve as a function of mounting base temperature; t_p = 100 μs; δ = 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 Ω; T_{mb} = 25 °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 °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 μs δ = 10% (see Fig. 2)	1.03 to 1.09	50	$\geqslant$ 300	$\geqslant$ 7	$\geqslant$ 38

MECHANICAL DATA

Dimensions in mm

FO-91 (see Fig. 1).

WARNING

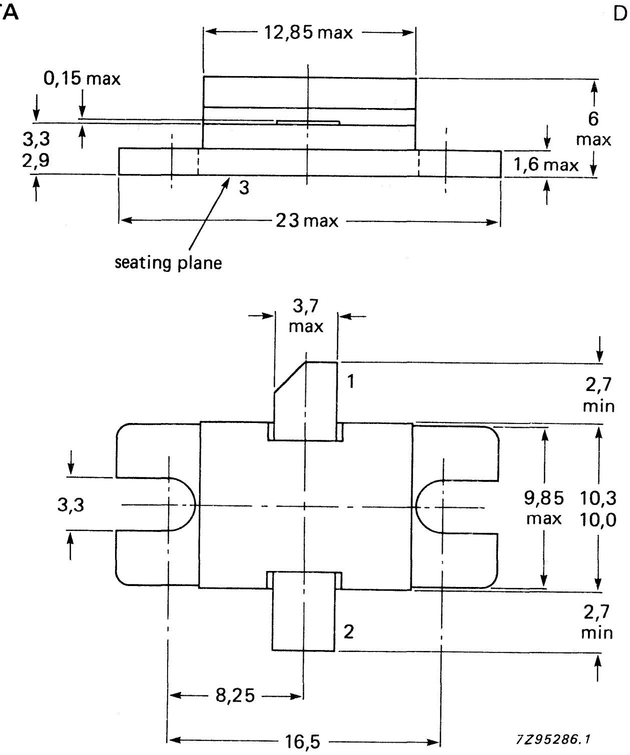
Product and environmental safety — toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.   **After use,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

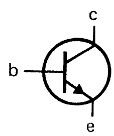
MECHANICAL DATA

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
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 $T_{mb} \leqslant 75$ °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; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	°C

THERMAL RESISTANCE (at T_j = 100 °C)

From junction to mounting base in CW	$R_{th\ j\text{-}mb}$	max.	0.8	K/W
From mounting base to heatsink in CW	$R_{th\ mb\text{-}h}$	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).

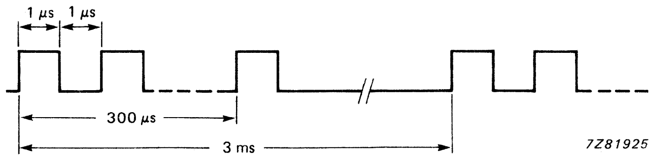


Fig. 2 Pulse definition.

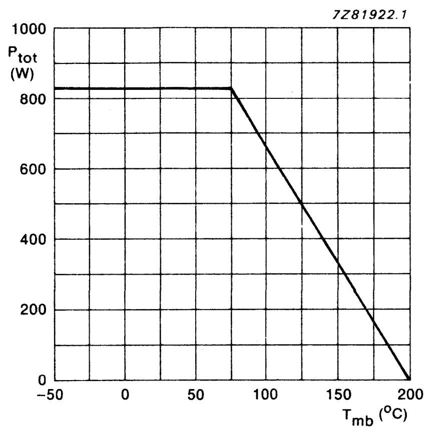


Fig. 3 Power derating curve.
t_p = 300 μs; δ = 10% (see Fig. 2).

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off current				
V_{CB} = 50 V; I_E = 0	I_{CBO}	max.	14	mA
V_{CB} = 60 V; I_E = 0	I_{CBO}	max.	140	mA
V_{CE} = 50 V; R_{BE} = 0	I_{CES}	max.	140	mA
Emitter cut-off current				
V_{EB} = 1.5 V; I_B = 0	I_{EBO}	max.	1.4	mA

APPLICATION INFORMATION

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

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %
pulsed t_p = 300 μs δ = 10% (see Fig. 2)	1.03 to 1.09	50	≥ 300 typ. 350	≥ 7 typ. 7.5	≥ 38 typ. 40

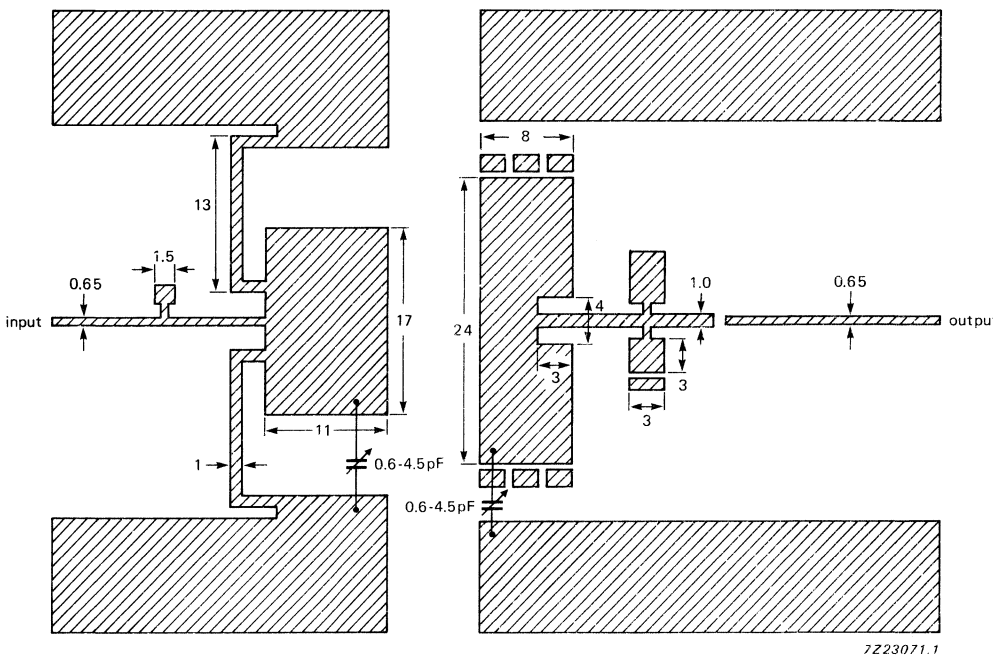


Fig. 4 Broadband test circuit for 1.03 to 1.09 GHz; class-C; pulse application. Epsilam printed circuit board thickness 0.635 mm; ϵ_r = 10 (dimensions in mm).

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 °C in a common-base class-C broadband amplifier.

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i; Z_L Ω
t_p = 1 ms; δ = 10%	1.2 to 1.4	40	⩾ 135	⩾ 6.5	⩾ 35	see Fig. 6

MECHANICAL DATA

Dimensions in mm

FO-91 (see Fig.1).

WARNING

Product and environmental safety — toxic materials

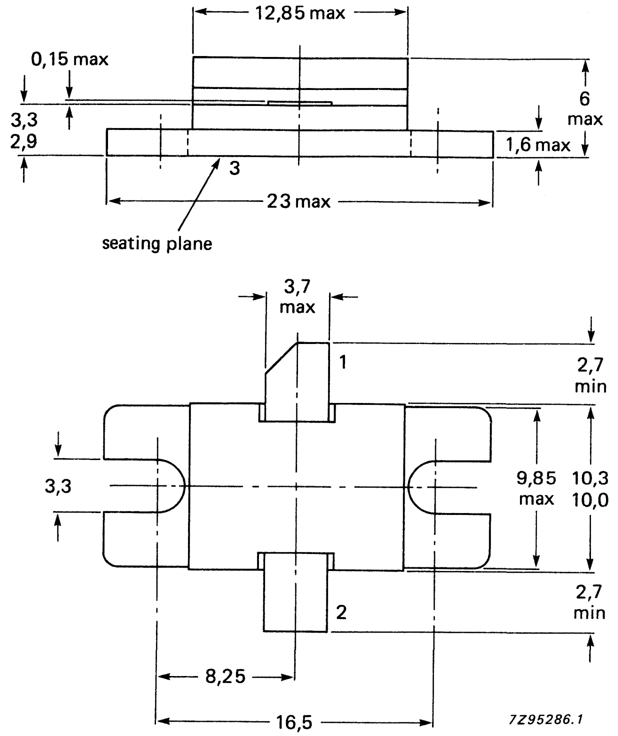
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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

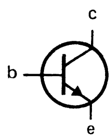
Dimensions in mm

Fig. 1 FO-91.



Pinning:
1 = collector
2 = emitter
3 = base

Base is connected to the seating plane.



RATINGS

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

Collector-base voltage; open emitter	V_{CBO}	max.	65 V
Collector-emitter voltage; $R_{BE} = 0$	V_{CES}	max.	60 V
Collector-emitter voltage; open base	V_{CEO}	max.	20 V
Emitter-base voltage; open collector	V_{EBO}	max.	3 V
Collector current (average)*	I_C	max.	15 A
Total power dissipation at $T_{mb} \leqslant 75\ ^oC$*	P_{tot}	max.	355 W
Storage temperature range	T_{stg}		−65 to + 200 ^oC
Operating junction temperature	T_j	max.	200 ^oC
Soldering temperature at 0.2 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 ^oC

THERMAL RESISTANCE (at $T_j = 75\ ^oC$)

From junction to mounting base (CW)	$R_{th\ j\text{-}mb}$	max.	1 K/W
From junction to heatsink**	Z_{th}	max.	0.35 K/W
From mounting base to heatsink (CW)	$R_{th\ mb\text{-}h}$	max.	0.2 K/W

* Maximum values under nominal pulsed microwave operating conditions (t_p = 1 ms; δ = 10%).
** Equivalent thermal impedance under nominal pulsed microwave operating conditions (t_p = 1 ms; δ = 10%).

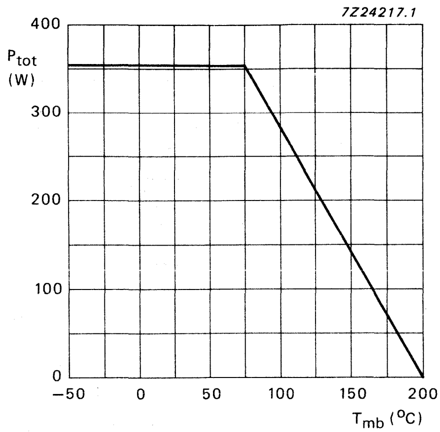


Fig. 2 Power derating curve t_p = 1 ms; δ = 10%.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Breakdown voltages			
I_C = 100 mA; I_E = 0	$V_{(BR)CBO}$	min.	65 V
I_C = 100 mA; R_{BE} = 0	$V_{(BR)CES}$	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; δ = 10%	1.2 to 1.4	40	⩾ 135 typ. 150	⩾ 6.5 typ. 7	⩾ 35 typ. 42	see Fig. 6
t_p = 150 μs δ = 5%	1.2 to 1.4	50	typ. 220	typ. 8	typ. 45	see Fig. 6

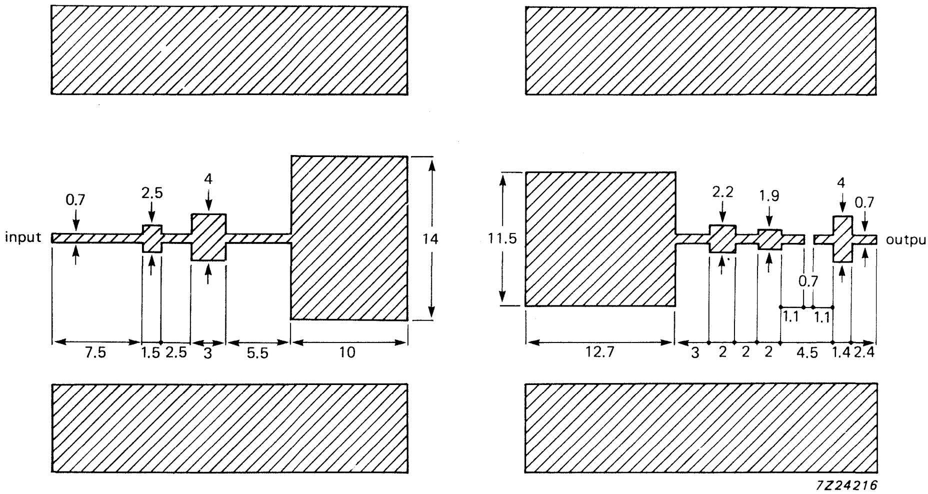


Fig. 3 Broadband test circuit for 1.2 to 1.4 GHz; class-C; pulse applications (dimensions in mm). Epsilam printed circuit board; thickness 0.635 mm; ϵ_r = 10.

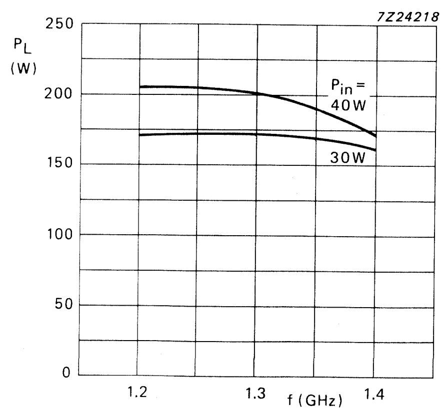


Fig. 4 Load power as a function of frequency; V_{CC} = 40 V; t_p = 1 ms; δ = 10%; typical values.

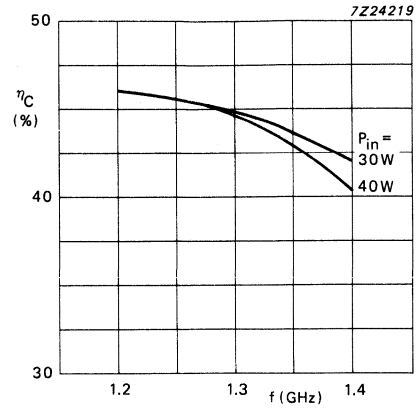


Fig. 5 Efficiency as a function of frequency;
t_p = 1 ms; δ = 10%; typical values.

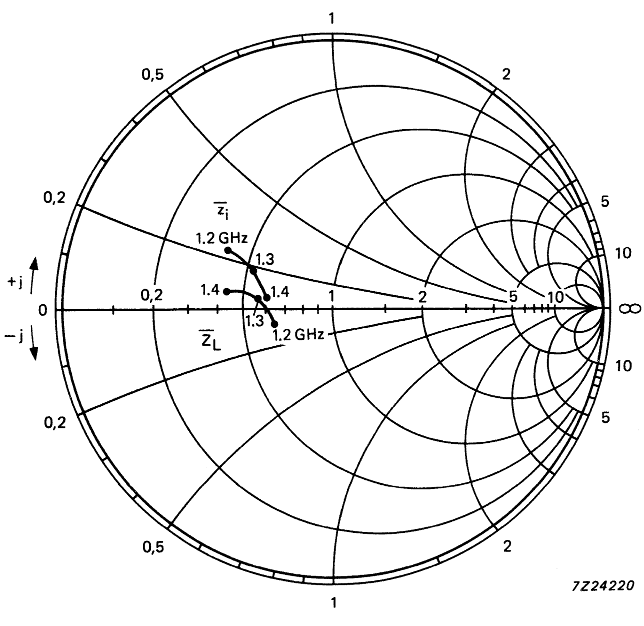


Fig. 6 Input and optimum load impedance as a function of frequency;
V_{CC} = 40 V; Z_O = 5 Ω.

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 °C in a common-base class-C wideband amplifier.

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i; Z_L
class-C; t_p = 150 μs; δ = 5%	1.2 to 1.4	50	$\geqslant$250	$\geqslant$7	$\geqslant$35	see Fig. 6

MECHANICAL DATA

Dimensions in mm

FO-91 (see Fig. 1).

WARNING

Product and environmental safety — toxic materials

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

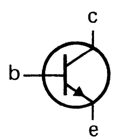
MECHANICAL DATA

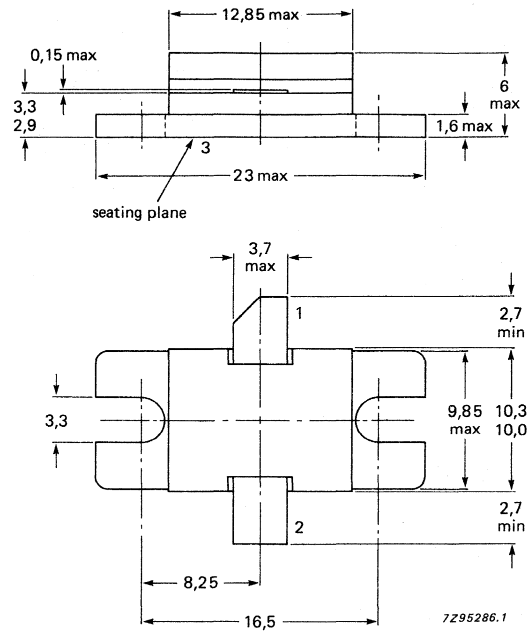
Dimensions in mm

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) $t_p \leqslant 150\ \mu s$; $\delta \leqslant 5\%$	I_C	max.	21	A
Total power dissipation up to $T_{mb} = 75\ ^oC$ $t_p \leqslant 150\ \mu s$; $\delta \leqslant 5\%$	P_{tot}	max.	570	W
Storage temperature range	T_{stg}		−65 to 200	^oC
Junction temperature	T_j	max.	200	^oC
Lead soldering temperature at 0.2 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	^oC

THERMAL RESISTANCE (at $T_j = 100\ ^oC$)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	0.8	K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2	K/W
Equivalent thermal impedance under pulsed microwave conditions; $t_p = 150\ \mu s$; $\delta = 5\%$	Z_{th}	typ.	0.22	K/W

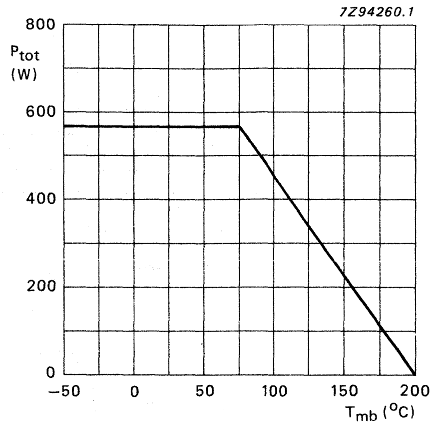


Fig. 2 Power derating curve; pulsed conditions; t_p = 150 μs; δ = 5%.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector-base breakdown voltage I_C = 140 mA; I_E = 0	$V_{(BR)CBO}$	min.	65	V
Collector-emitter breakdown voltage I_C = 140 mA; R_{BE} = 0	$V_{(BR)CES}$	min.	50	V
Emitter-base breakdown voltage I_C = 0; I_E = 20 mA	$V_{(BR)EBO}$	min.	3	V
Collector cut-off current I_E = 0; V_{CB} = 50 V	I_{CBO}	max.	14	mA
Emitter cut-off current I_C = 0; V_{EB} = 1.5 V	I_{EBO}	max.	1.4	mA

APPLICATION INFORMATION

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

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i; Z_L
pulsed; t_p = 150 μs; δ = 5%	1.2 to 1.4	50	⩾ 250 typ. 320	⩾ 7 typ. 8	⩾ 35 typ. 40	see Fig. 6
t_p = 300 μs; δ = 10%	1.2 to 1.4	50	typ. 300	typ. 7.5	typ. 35	see Fig. 6

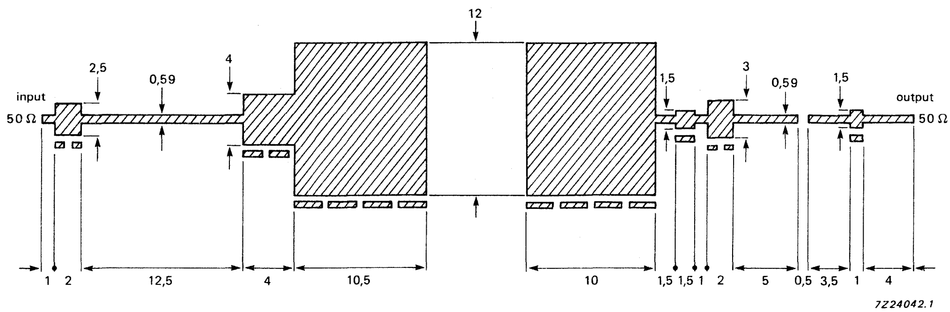


Fig. 3 Wideband test circuit for 1.2 to 1.4 GHz (dimensions in mm).
Epsilam printed circuit board; thickness 0.635 mm; $\epsilon_r = 10$.

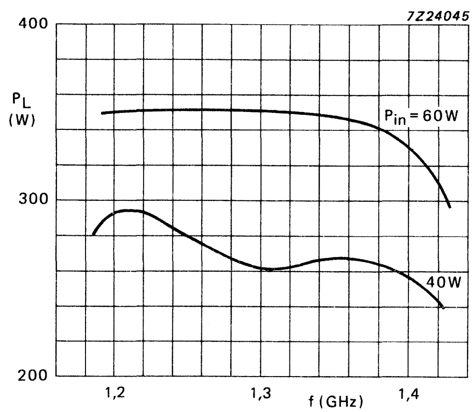


Fig. 4 Load power as a function of frequency; typical values;
$t_p = 150\ \mu s$; $\delta = 5\%$.

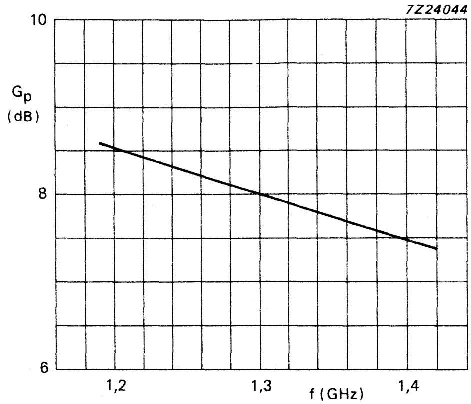


Fig. 5 Power gain as a function of frequency; t_p = 150 μs; δ = 5%.

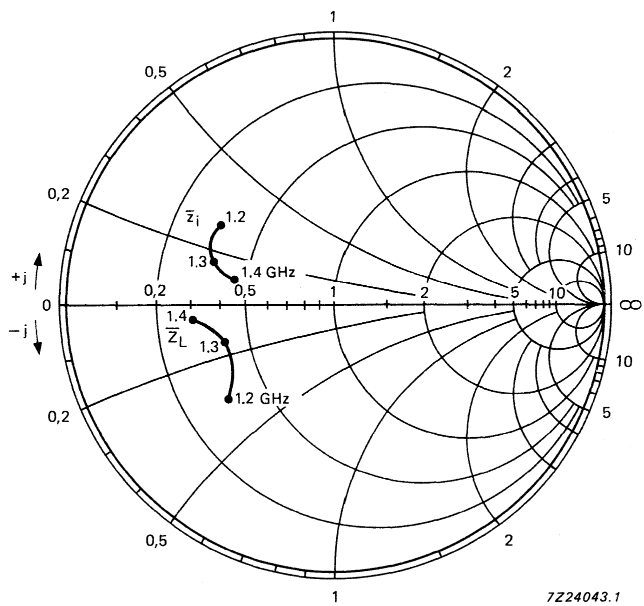


Fig. 6 Input and optimum load impedance as a function of frequency; V_{CC} = 50 V; P_L = 250 W; t_p = 150 μs; δ = 5%; class-C operation; Z_O = 5 Ω; typical values.

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 °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 µs; δ = 10%	2.7 to 3.1	40	⩾ 90	⩾ 6	⩾ 35	see Fig. 5

MECHANICAL DATA

Dimensions in mm

FO-125A (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.

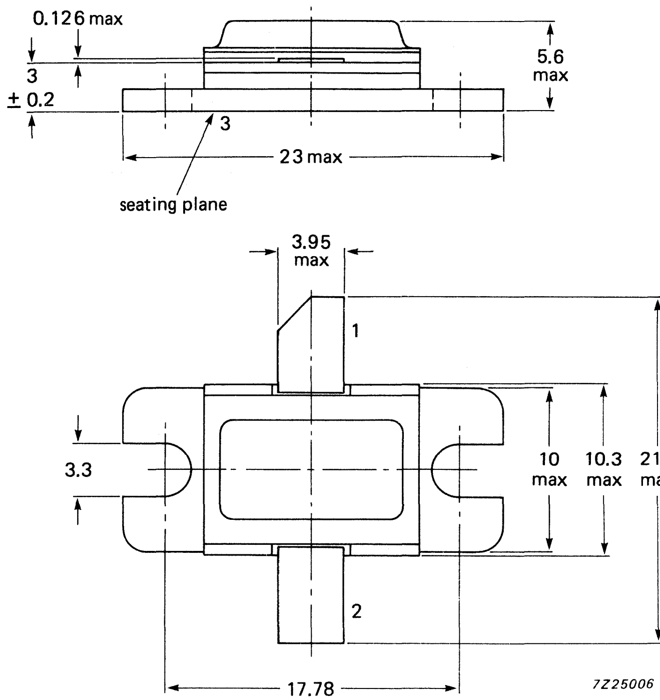
After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with general industrial or domestic waste.

MECHANICAL DATA

Dimensions in mm

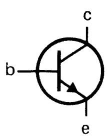
Fig. 1 FO-125A.

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_{CBO}	max.	50 V
Collector-emitter voltage,			
R_{BE} = 0	V_{CES}	max.	50 V
open base	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 °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; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 °C

THERMAL RESISTANCE (at T_j = 100 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	1.7 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.3 K/W
Equivalent thermal impedance under pulse microwave conditions t_p = 100 μs; δ = 10%	$Z_{th\ j\text{-}mb}$	max.	0.55 K/W

* Maximum value under nominal pulsed microwave operating conditions (t_p = 100 μs; δ = 10%).

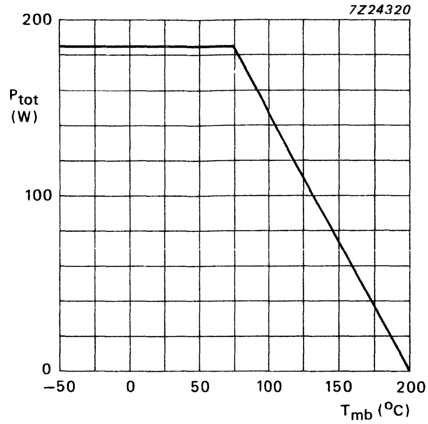


Fig. 2 Power derating curve; t_p = 100 μs; δ = 10%.

DEVELOPMENT DATA

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off current			
V_{CB} = 50 V; I_E = 0	I_{CBO}	max.	30 mA
V_{CB} = 30 V; I_E = 0	I_{CBO}	max.	150 μA
V_{CB} = 50 V; R_{BE} = 0	I_{CES}	max.	30 mA ←
Emitter cut-off current			
V_{EB} = 1.5 V; I_C = 0	I_{EBO}	max.	150 μA
V_{EB} = 3.5 V; I_C = 0	I_{EBO}	max.	7 mA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °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 μs; δ = 10%	2.7 to 3.1	40	⩾ 90 typ. 100	⩾ 6 typ. 6.5	⩾ 35 typ. 40	see Fig. 5 ←

* During pulse.

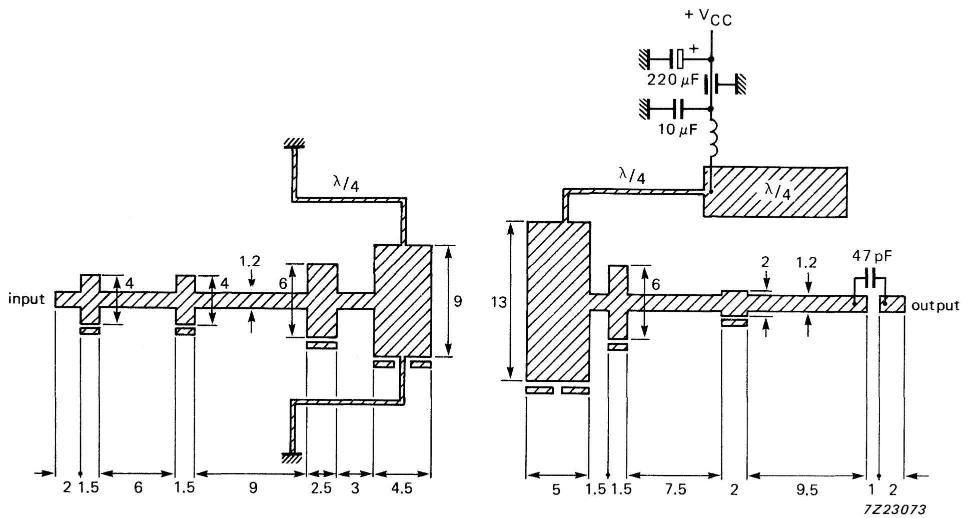


Fig. 3 Broadband test circuit for 3.0 to 3.4 GHz. (dimensions in mm).
PTFE fibreglass printed circuit board; ϵ_r = 2.55; thickness 0.4 mm.

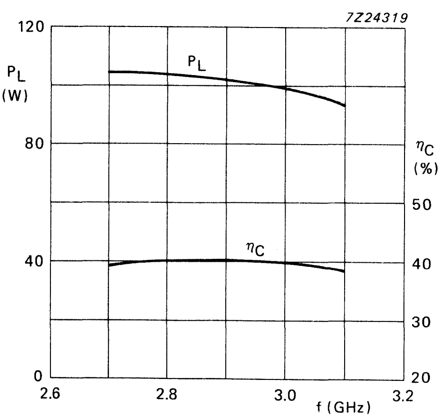


Fig. 4 Load power and collector efficiency as a function of frequency*;
V_{CC} = 40 V; t_p = 100 μs; δ = 10%; typical values.

* In a broadband test circuit as shown in Fig. 3.

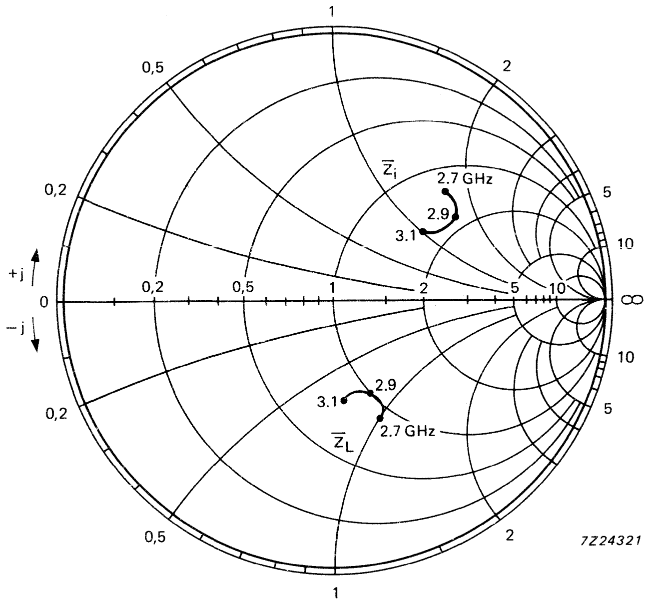


Fig. 5 Input and optimum load impedance as a function of frequency; $Z_O = 5\ \Omega$; $V_{CC} = 40$ V; typical values.

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 °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 μs; δ = 10%	3.0 to 3.4	40	≥ 70	≥ 5.4	≥ 30	see Fig. 5

MECHANICAL DATA

Dimensions in mm

FO-125A (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

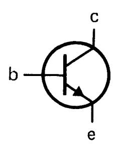
Dimensions in mm

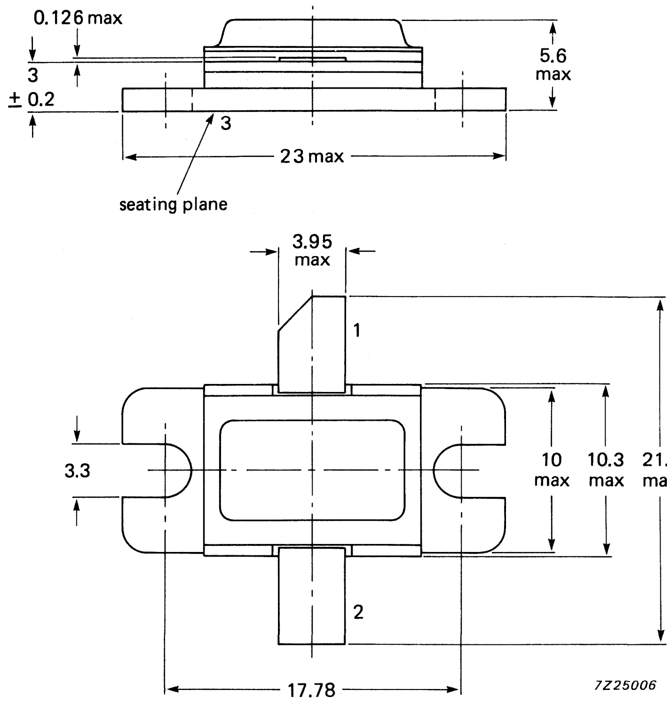
Fig. 1 FO-125A.

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_{CBO}	max.	50	V
Collector-emitter voltage,				
→ $R_{BE} = 0$	V_{CES}	max.	50	V
open base	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 $T_{mb} = 75\ ^oC$*	P_{tot}	max.	185	W
Storage temperature range	T_{stg}		−65 to + 200	^oC
Junction temperature	T_j	max.	200	^oC
→ Soldering temperature up to 0.2 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	^oC

THERMAL RESISTANCE (at $T_j = 100\ ^oC$)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	1.7	K/W
→ From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.3	K/W
Equivalent thermal impedance under pulse microwave conditions $t_p = 100\ \mu s$; $\delta = 10\%$	$Z_{th\ j\text{-}mb}$	max.	0.55	K/W

→ * Maximum value under nominal pulsed microwave operating conditions ($t_p = 100\ \mu s$; $\delta = 10\%$).

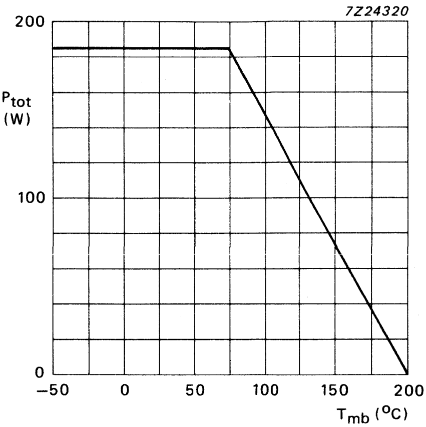


Fig. 2 Power derating curve; t_p = 100 μs; δ = 10%.

DEVELOPMENT DATA

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off current			
V_{CB} = 50 V; I_E = 0	I_{CBO}	max.	30 mA
V_{CB} = 30 V; I_E = 0	I_{CBO}	max.	150 μA
V_{CB} = 50 V; R_{BE} = 0	I_{CES}	max.	30 mA ←
Emitter cut-off current			
V_{EB} = 1.5 V; I_C = 0	I_{EBO}	max.	150 μA
V_{EB} = 3.5 V; I_C = 0	I_{EBO}	max.	7 mA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °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 μs; δ = 10%	3.0 to 3.4	40	≥ 70 typ. 80	≥ 5.4 typ. 6	≥ 30 typ. 35	see Fig. 5 ←

* During pulse.

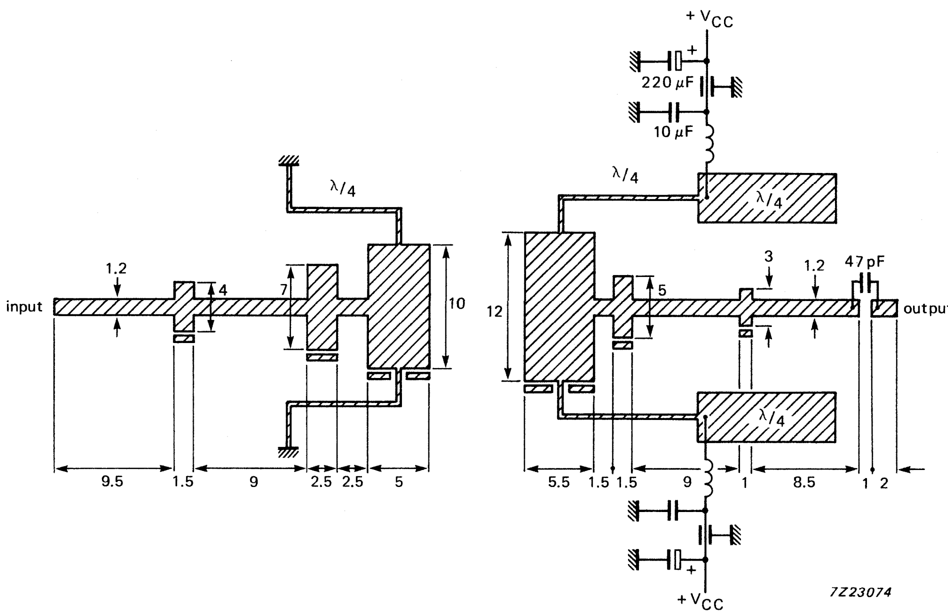


Fig. 3 Broadband test circuit for 3.0 to 3.4 GHz. (dimensions in mm).
PTFE fibreglass printed circuit board; ϵ_r = 2.55; thickness 0.4 mm.

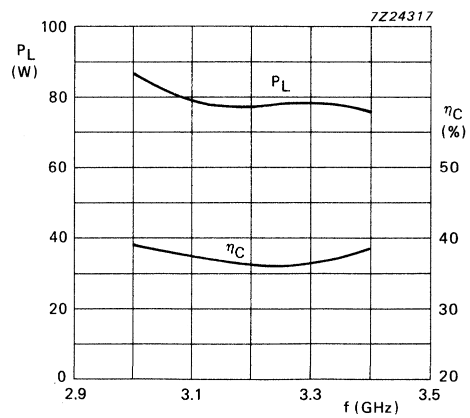


Fig. 4 Load power and collector efficiency as a function of frequency*; V_{CC} = 40 V, t_p = 100 µs; δ = 10%; typical values.

* In a broadband test circuit as shown in Fig. 3.

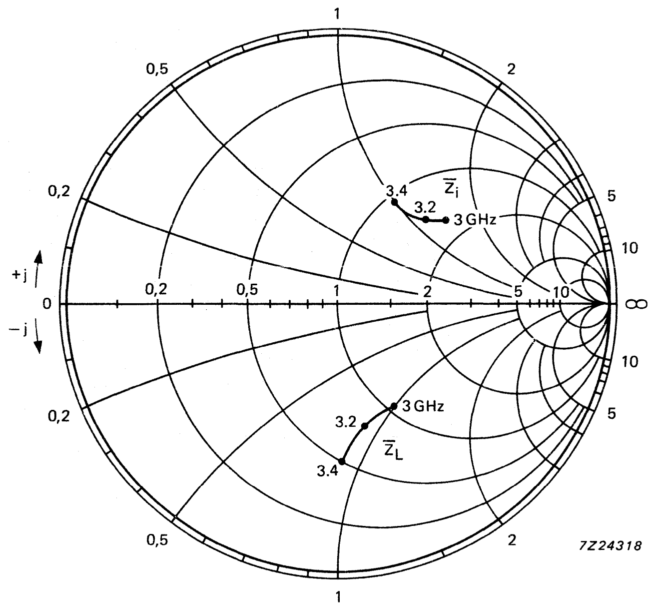


Fig. 5 Input and optimum load impedance as a function of frequency; Z_O = 5 Ω; V_{CC} = 40 V; typical values.

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 °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-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

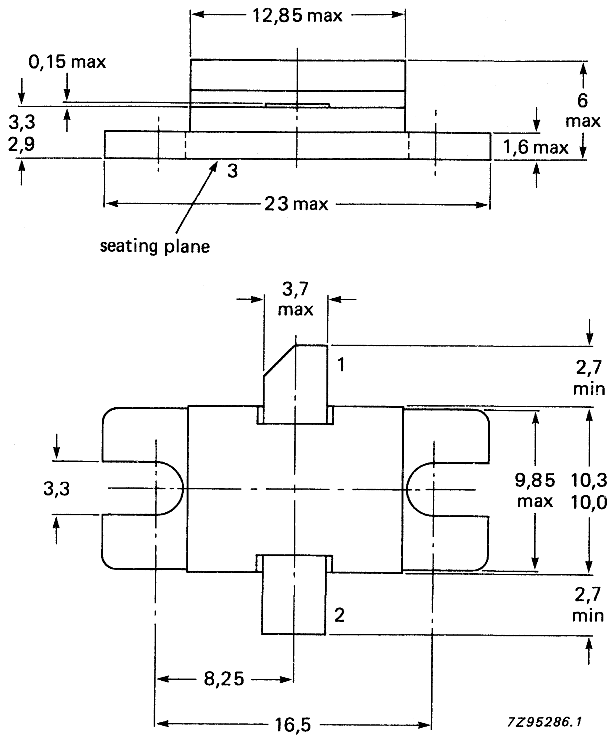
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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_{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 μs, $\delta \leqslant$ 10%	I_C	max.	21 A
Total power dissipation up to T_{mb} = 75 °C t_p = 100 μs, $\delta \leqslant$ 10%	P_{tot}	max.	570 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, $t_{sld} \leqslant$ 10 s	T_{sld}	max.	235 °C

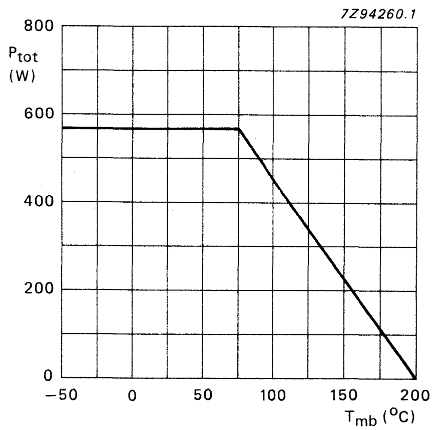


Fig. 2 Power derating curve as a function of mounting base temperature; t_p = 100 μs, δ = 10%.

THERMAL RESISTANCE (at T_j = 100 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	0.8 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2 K/W
Equivalent thermal impedance t_p = 100 μs; δ = 10%	Z_{th}	max.	0.22 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Breakdown voltages I_C = 140 mA; I_E = 0	$V_{(BR)CBO}$	min.	65 V
I_C = 140 mA; R_{BE} = 0	$V_{(BR)CES}$	min.	60 V
I_C = 0; I_E = 20 mA	$V_{(BR)EBO}$	min.	3 V
Collector cut-off current I_E = 0; V_{CB} = 50 V	I_{CBO}	max.	14 mA

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 °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 μs; δ = 10%	1,09	50	≥ 300 typ. 350	≥ 7 typ. 7.8	≥ 30 typ. 38

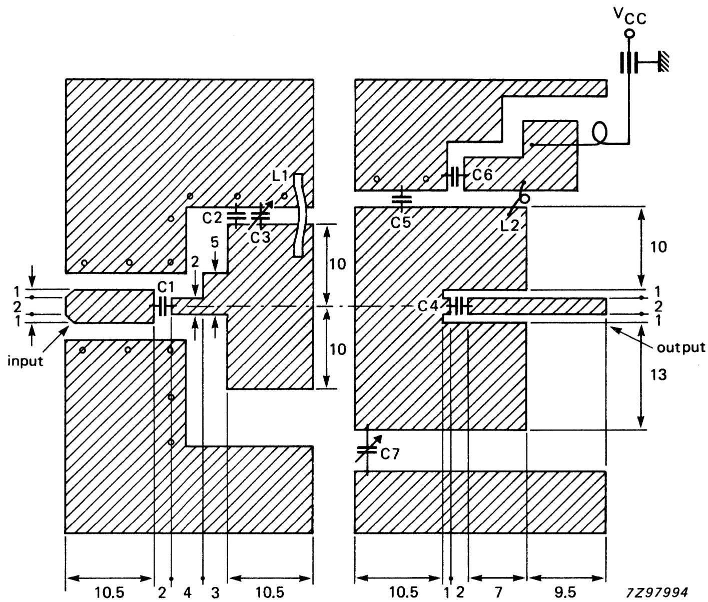


Fig. 3 Narrowband test circuit for 1.09 GHz (dimensions in mm).
PTFE printed circuit board; thickness 0.8 mm; ϵ_r = 2.55.

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 °C in a common-base class-C wideband amplifier

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
class C t_p = 150 μs δ = 5%	1.2 to 1.4	50	⩾ 35	⩾ 7	⩾ 30	see Fig. 6	

MECHANICAL DATA

FO-57C (see Fig. 1).

WARNING

Product and environmental safety — toxic materials

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

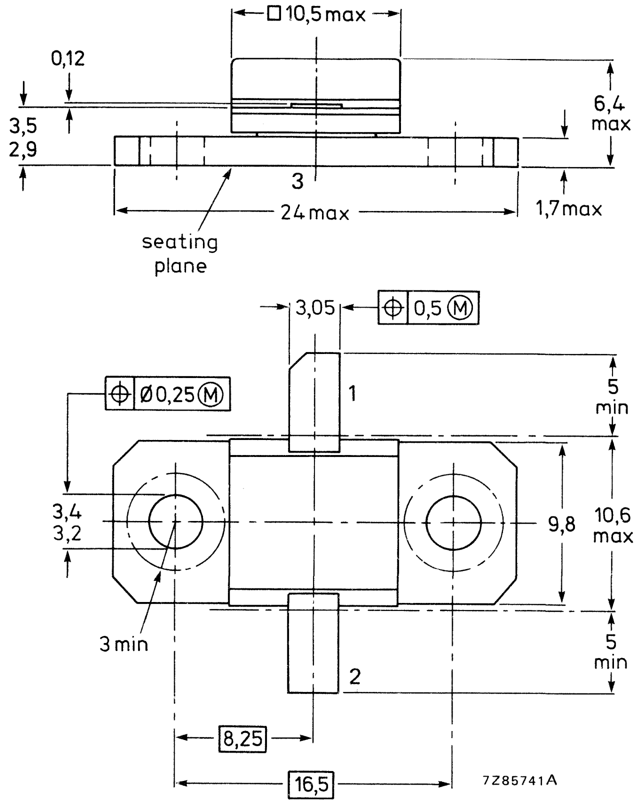
Dimensions in mm

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) $t_p \leqslant 150\ \mu s$; $\delta \leqslant 5\%$	I_C	max.	3 A
Total power dissipation up to $T_{mb} = 75\ ^oC$ $t_p \leqslant 150\ \mu s$; $\delta \leqslant 5\%$	P_{tot}	max.	125 W
Storage temperature range	T_{stg}		−65 to 200 °C
Junction temperature	T_j	max.	200 °C
Lead soldering temperature at 0.2 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 °C

THERMAL RESISTANCE (at $T_j = 75\ ^oC$)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	5.0 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2 K/W
Equivalent thermal impedance under pulsed microwave conditions $t_p = 100\ \mu s$; $\delta = 10\%$	Z_{th}	max.	1.0 K/W

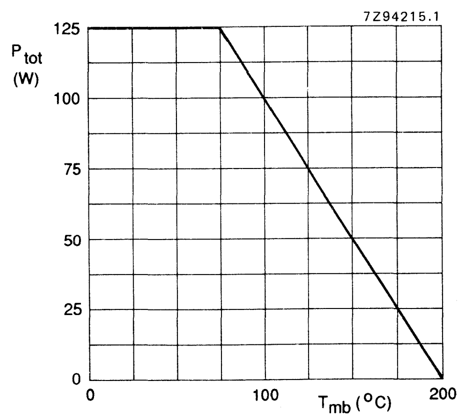


Fig. 2 Power derating curve as a function of mounting base temperature (under pulsed conditions: $t_p = 150\ \mu s$, $\delta = 5\%$).

CHARACTERISTICS

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

Collector-base breakdown voltage $I_C = 20$ mA; $I_E = 0$	$V_{(BR)CBO}$	min.	65 V
Collector-emitter breakdown voltage $I_C = 20$ mA; $R_{BE} = 0$	$V_{(BR)CES}$	min.	60 V
Emitter-base breakdown voltage $I_C = 0$; $I_E = 3$ mA	$V_{(BR)EBO}$	min.	3 V
Collector cut-off current $I_E = 0$; $V_{CB} = 50$ V	I_{CBO}	max.	2 mA
Emitter cut-off current $I_C = 0$; $V_{EB} = 1.5$ V	I_{EBO}	max.	200 μA

PRODUCT TEST

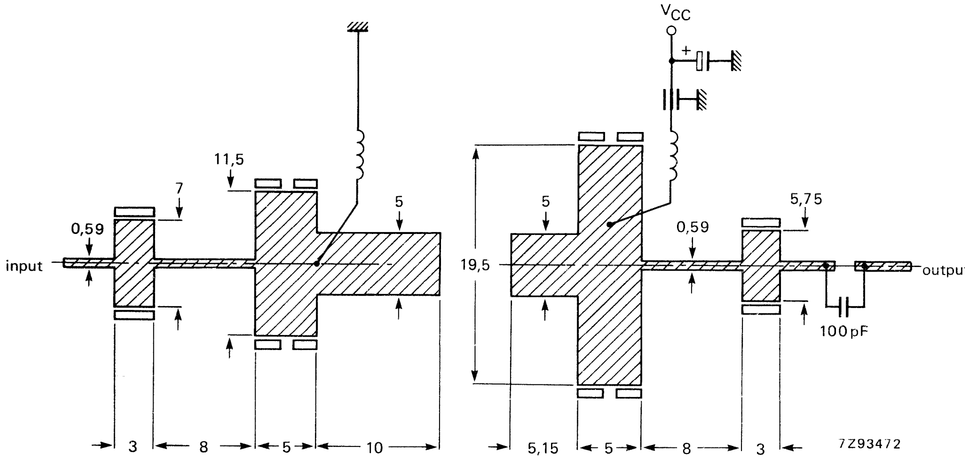


Fig. 3 Wideband test circuit for 1.2 to 1.4 GHz (dimensions in mm).
Epsilam p.c. board, thickness 0.635 mm, ϵ_r = 10.

The transistors are 100% tested on above test circuit and under the following conditions:

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
class-C t_p = 150 μs δ = 5%	1.2 to 1.4	50	typ. 40 > 35	typ. 7.8 > 7	typ. 35 > 35	see Fig. 6	
t_p = 300 μs δ = 10%	1.2 to 1.4	50	typ. 40	typ. 7	typ. 35		

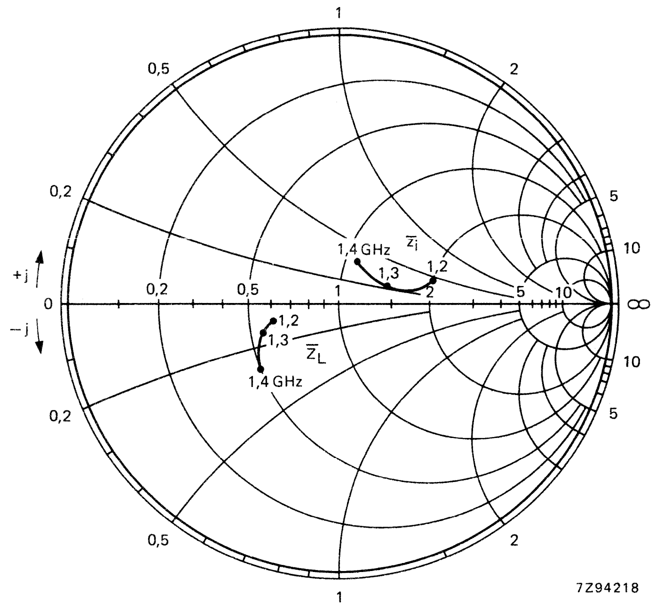


Fig. 4 Input and optimum load impedances as a function of frequency; Z_O = 5 Ω.

Conditions for Fig. 4:

V_{CE} = 50 V; P_L = 35 W; t_p = 150 μs; δ = 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 ^{o}C in a common-base class-B wideband amplifier.

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	z_i Ω	Z_L Ω
class-B; t_p = 150 μs; δ = 5%	1.2 to 1.4	50	$\geqslant$ 70	$\geqslant$ 7	$\geqslant$ 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

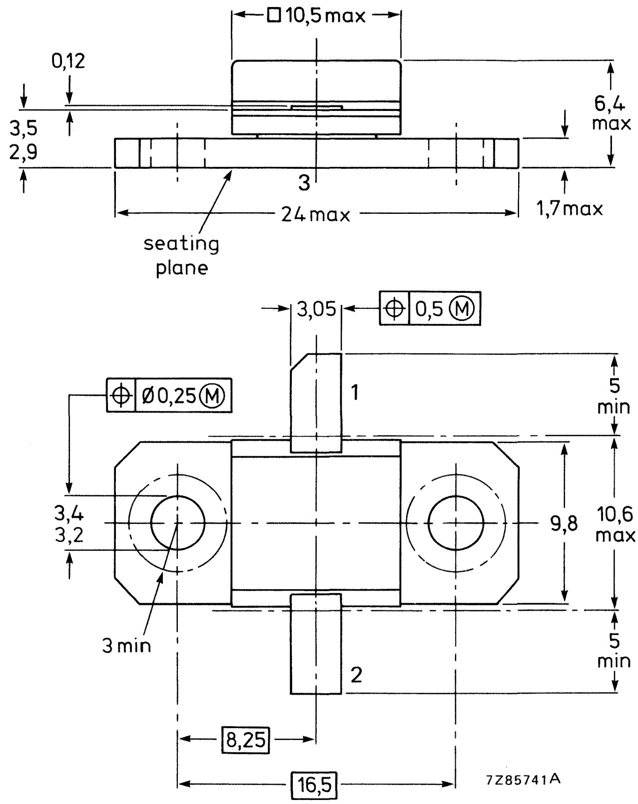
Dimensions in mm

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) $t_p \leqslant 150\ \mu s$; $\delta \leqslant 5\%$	I_C	max.	6	A
Total power dissipation up to $T_{mb} = 75\ ^oC$ $t_p \leqslant 150\ \mu s$; $\delta \leqslant 5\%$	P_{tot}	max.	225	W
Storage temperature range	T_{stg}		−65 to + 200	^oC
Junction temperature	T_j	max.	200	^oC
Lead soldering temperature at 0.2 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	^oC

THERMAL RESISTANCE (at $T_j = 75\ ^oC$)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	2.5	K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2	K/W
Equivalent thermal impedance under pulsed microwave conditions; $t_p = 150\ \mu s$; $\delta = 5\%$	Z_{th}	max.	0.55	K/W

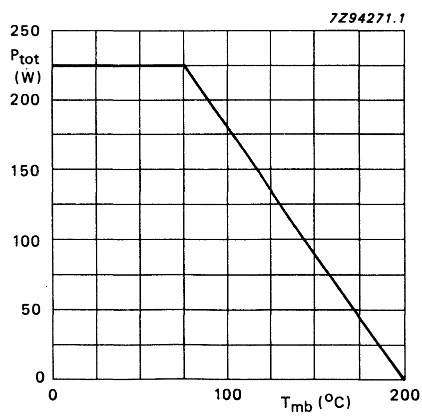


Fig.2 Power derating curve as a function of mounting base temperature (under pulsed conditions: $t_p = 150\ \mu s$, $\delta = 5\%$).

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector-base breakdown voltage I_C = 40 mA; I_E = 0	$V_{(BR)CBO}$	min.	65 V
Collector-emitter breakdown voltage I_C = 40 mA; R_{BE} = 0	$V_{(BR)CES}$	min.	60 V
Emitter-base breakdown voltage I_C = 0; I_E = 6 mA	$V_{(BR)EBO}$	min.	3 V
Collector cut-off current I_E = 0; V_{CB} = 50 V	I_{CBO}	max.	4 mA
Emitter cut-off current I_C = 0; V_{EB} = 1.5 V	I_{EBO}	max.	400 μA

PRODUCT TEST

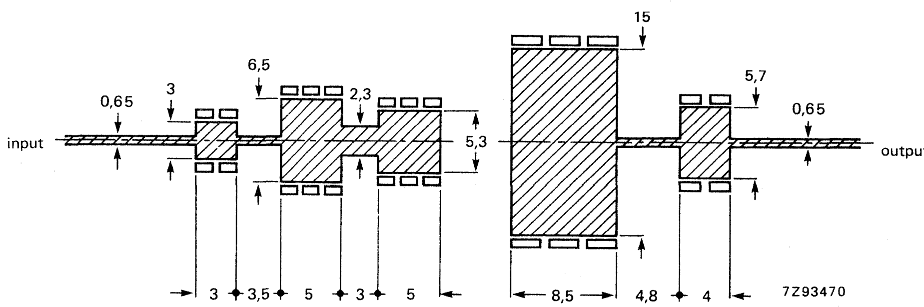


Fig.3 Wideband test circuit for 1.2 to 1.4 GHz (dimensions in mm).
Epsilam p.c. board, thickness 0.635 mm, ϵ_r = 10.

The transistors are 100% tested on above test circuit and under the following conditions:

mode of operation	f GHz	V_{CC} V	P_L W	G_p dB	η_C %	$\bar{z}_i$ Ω	$\bar{Z}_L$ Ω
class-C; t_p = 150 μs; δ = 5%	1.2 to 1.4	50	> 70 typ. 80	> 7 typ. 7.8	> 35 typ. 40	see Fig.6	
t_p = 300 μs; δ = 10%	1.2 to 1.4	50	typ. 80	typ. 7	typ. 30		

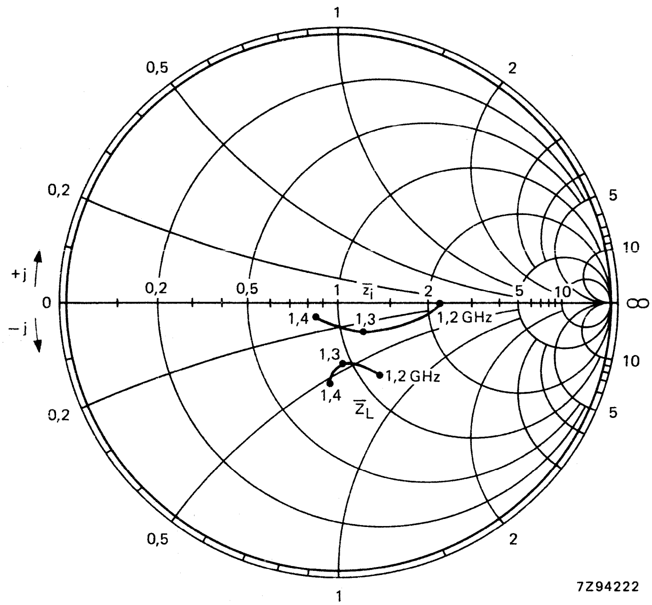


Fig.4 Input and optimum load impedance as a function of frequency; Z_O = 5 Ω.

Conditions for Fig. 4:
V_{CE} = 50 V; P_L = 65 W; t_p = 150 μs; δ = 5%; class-C operation.

Philips Components

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 °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

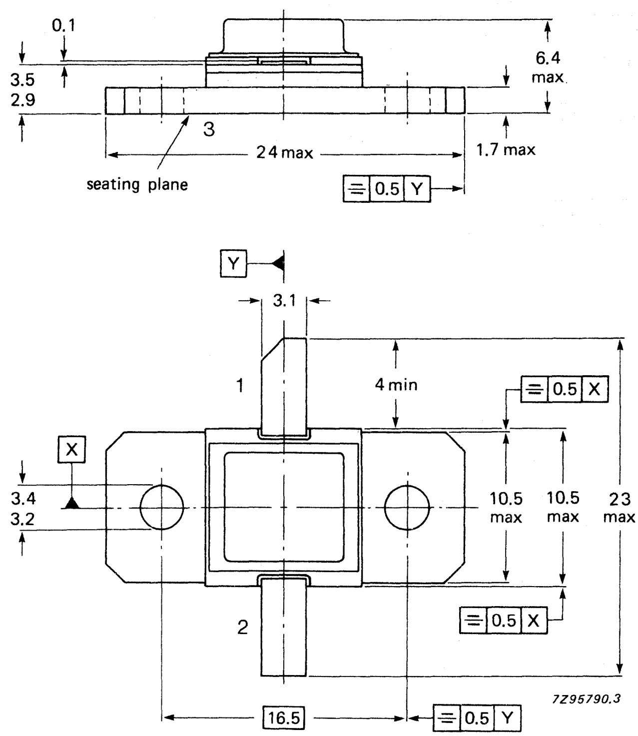
Product and environmental safety — toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose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

RZ2731B16W

MECHANICAL DATA

Dimensions in mm



Base is connected to seating plane.

Fig.1 FO-57D.

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	$T_{mb} = 75\ °C$; $t_p = 100\ \mu s$; $\delta = 10\%$; note 1	–	35	W
T_{stg}	storage temperature range		–65	200	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leqslant 10$ s; up to 0.2 mm from ceramic	–	235	°C

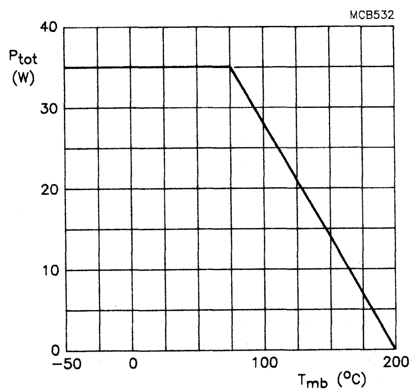


Fig.2 Maximum power dissipation derating as a function of mounting base temperature; $t_p = 100\ \mu s$; $\delta = 10\%$; P_{tot} max = 35 W.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	CW	6.5	K/W
$R_{th\ mb\text{-}h}$	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

RZ2731B16W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 40 V; I_E = 0	300	μA
I_{CES}	collector cut-off current	V_{CE} = 40 V; R_{BE} = 0 Ω	1	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	25	μA

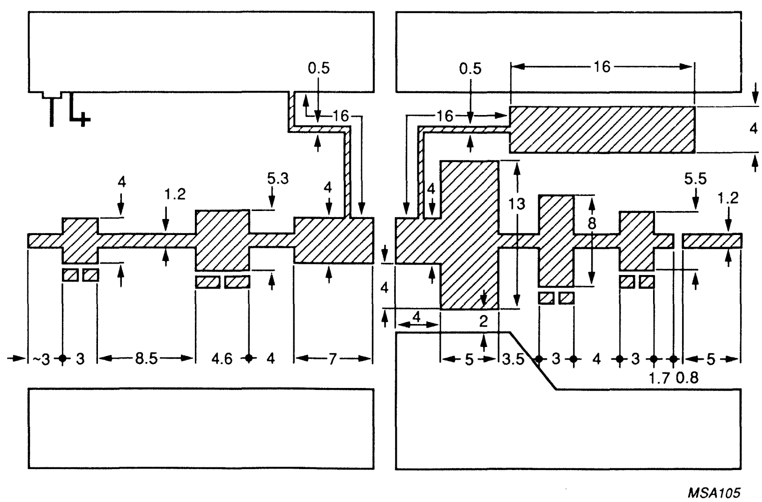
APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C measured in the test jig as shown in Fig.3 and working in class C broadband mode in pulse (t_p = 100 μs; δ = 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 μs; δ = 10%	2.7 to 3.1	40	> 15 typ. 16	> 6 typ. 6.3	> 32 typ. 38	see Figs 6 and 7

Notes

1. V_{CC} during pulse.



Substrate: Teflon fibre glass
Thickness: 0.4 mm
ϵ_r = 2.54
Dimensions in mm

Fig.3 Broadband test circuit.

NPN silicon planar epitaxial microwave power transistor

RZ2731B16W

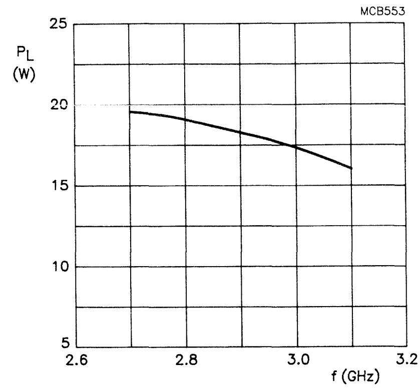


Fig.4 Load power P_L as a function of frequency; V_{CC} = 40 V; t_p = 100 μs; δ = 10%.
(In broadband test circuit as shown in Fig.3).

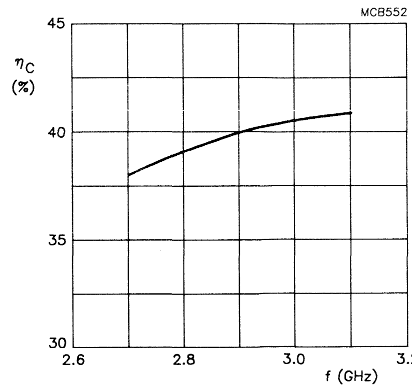


Fig.5 Collector efficiency as a function of frequency.
(In broadband test circuit as shown in Fig.3).

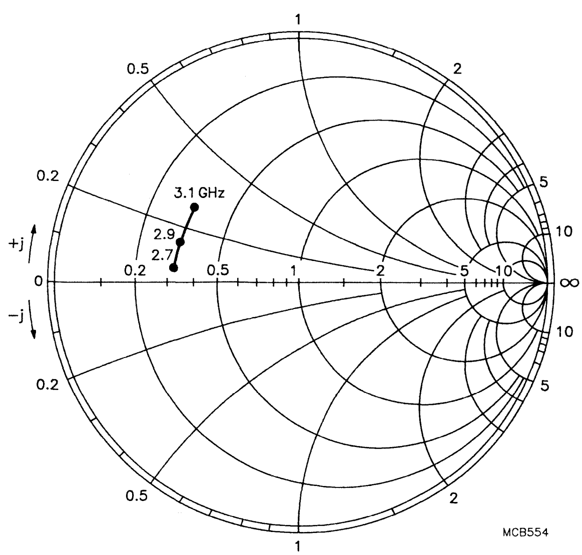


Fig.6 Input impedance as a function of frequency for P_L = 16 W; associated with optimum load impedance; V_{CC} = 40 V; Z_o = 50 Ω.

NPN silicon planar epitaxial microwave power transistor

RZ2731B16W

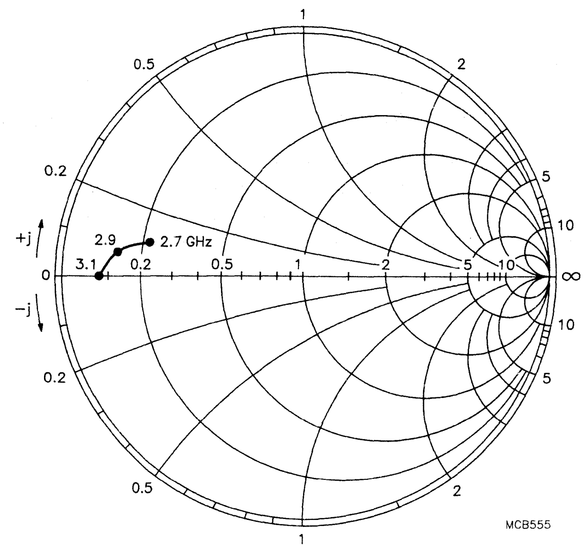


Fig.7 Optimum load impedance as a function of frequency for P_L = 16 W; associated with input impedance; V_{CC} = 40 V; Z_o = 50 Ω.

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 °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 μs; δ = 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

Dimensions in mm

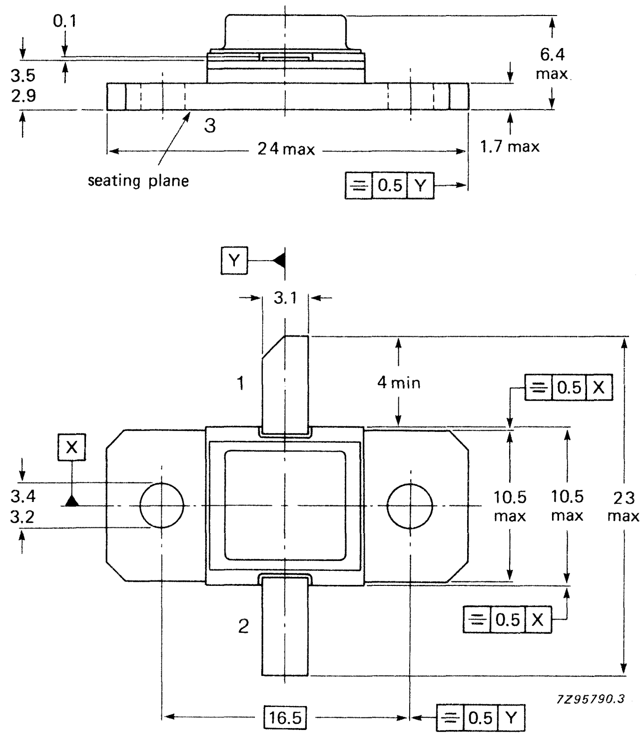


Fig.1 FO-57D.

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 µs; δ = 10%; note 1	–	2.8	A
P_{tot}	total power dissipation	T_{mb} = 75 °C; t_p = 100 µs; δ = 10%; note 1	–	70	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

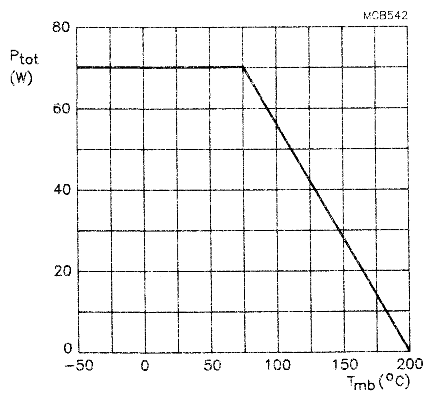


Fig.2 Maximum power dissipation derating as a function of mounting base temperature; t_p = 100 µs; δ = 10%; P_{tot} max = 70 W.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	CW	3.8	K/W
$R_{th\ mb\text{-}h}$	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 µs; δ = 10%).
2. Equivalent thermal impedance under nominal pulse microwave operating conditions (t_p = 100 µs; δ = 10%).

NPN silicon planar epitaxial microwave power transistor

RZ2731B32W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 40 V; I_E = 0	600	μA
I_{CES}	collector cut-off current	V_{CE} = 40 V; R_{BE} = 0 Ω	2	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	50	μA

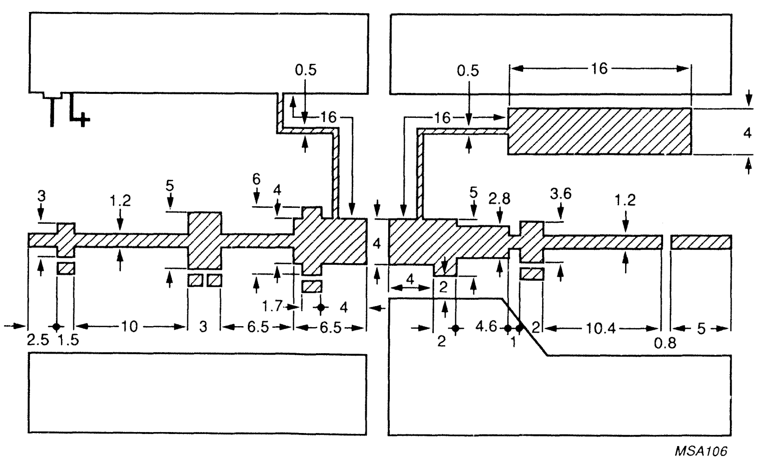
APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C measured in the test jig as shown in Fig.3 and working in class C broadband mode in pulse (t_p = 100 μs; δ = 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 μs; δ = 10%	2.7 to 3.1	40	> 30 typ. 32	> 6 typ. 6.3	> 32 typ. 38	see Figs 6 and 7

Notes

1. V_{CC} during pulse.



Substrate: Teflon fibre glass
Thickness: 0.4 mm
ϵ_r = 2.54
Dimensions in mm

Fig.3 Broadband test circuit.

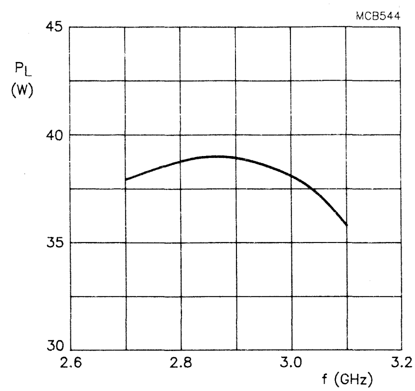


Fig.4 Load power P_L as a function of frequency; V_{CC} = 40 V; t_p = 100 μs; δ = 10%.
(In broadband test circuit as shown in Fig.3).

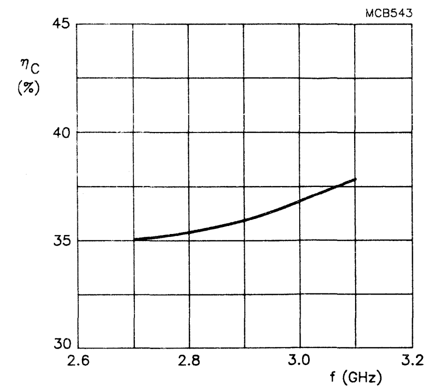


Fig.5 Collector efficiency as a function of frequency.
(In broadband test circuit as shown in Fig.3).

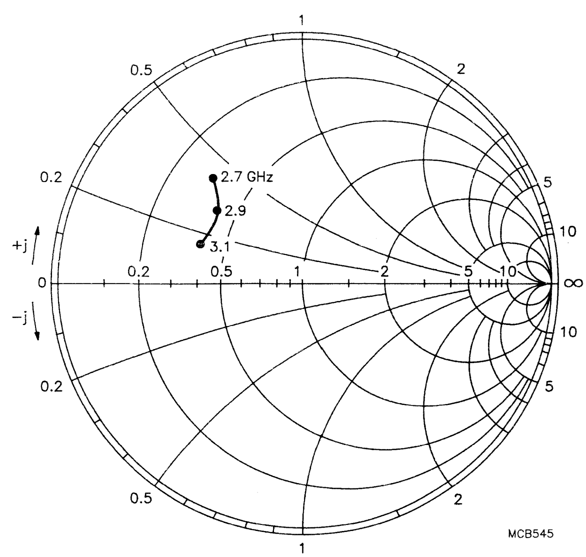


Fig.6 Input impedance as a function of frequency for P_L = 32 W; associated with optimum load impedance; V_{CC} = 40 V; Z_o = 50 Ω.

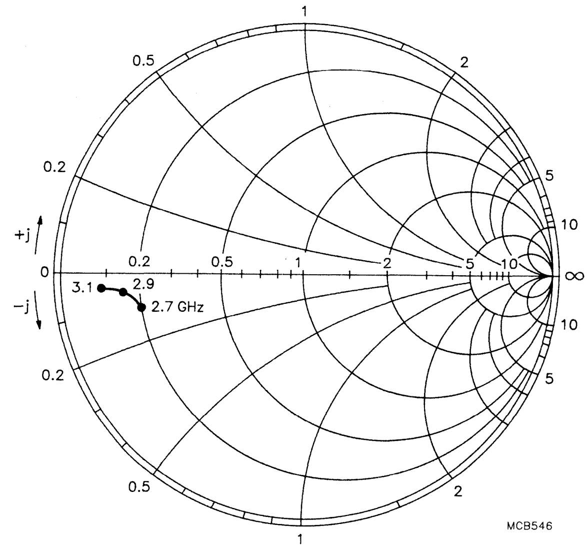


Fig.7 Optimum load impedance as a function of frequency for P_L = 32 W; associated with input impedance; V_{CC} = 40 V; Z_o = 50 Ω.

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 °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	> 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

Dimensions in mm

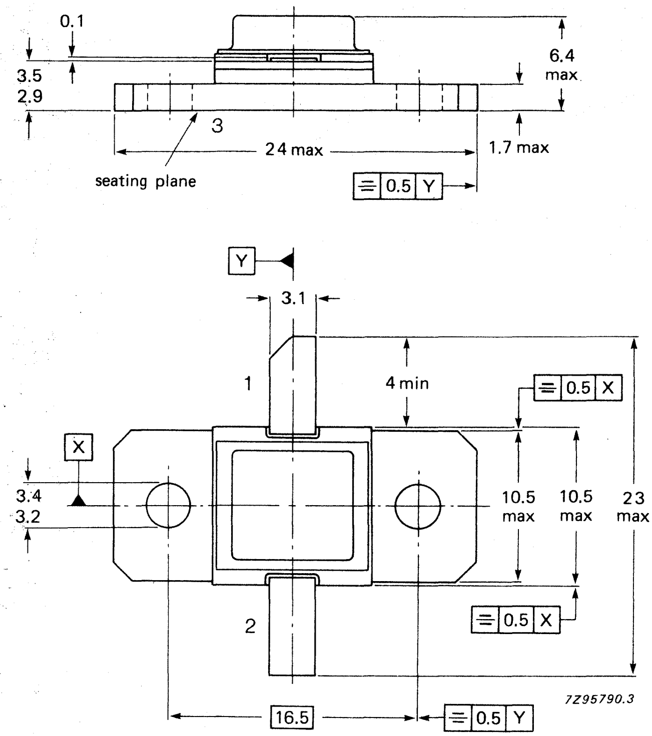


Fig.1 FO-57D.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	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	$T_{mb} = 75\ °C$; $t_p = 100\ \mu s$; $\delta = 10\%$; note 1	–	100	W
T_{stg}	storage temperature range		–65	200	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s; up to 0.2 mm from ceramic	–	235	°C

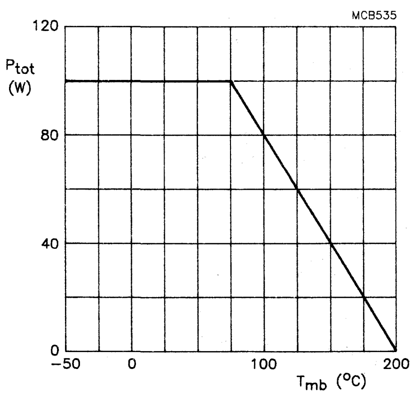


Fig.2 Maximum power dissipation derating as a function of mounting base temperature; $t_p = 100\ \mu s$; $\delta = 10\%$; P_{tot} max = 100 W.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	CW	2.8	K/W
$R_{th\ mb\text{-}h}$	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 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 40 V; I_E = 0	900	μA
I_{CES}	collector cut-off current	V_{CE} = 40 V; R_{BE} = 0 Ω	3	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	75	μA

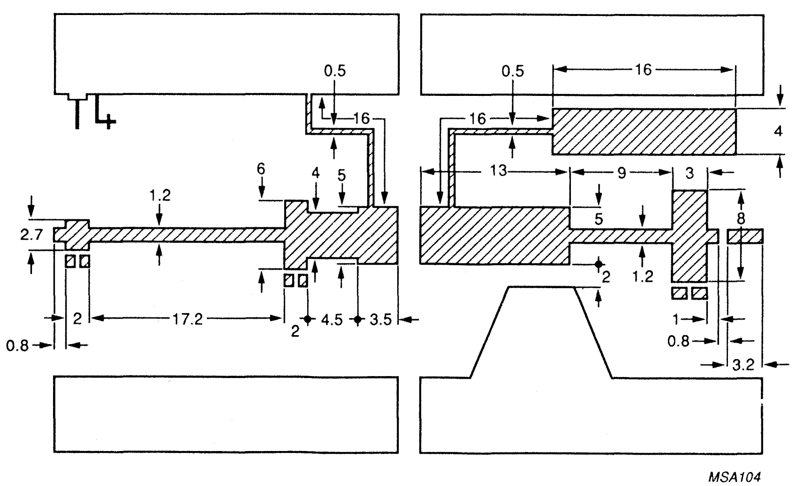
APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C measured in the test jig as shown in Fig.3 and working in class C broadband mode in pulse (t_p = 100 μs; δ = 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 μs; δ = 10%	2.7 to 3.1	40	> 45 typ. 48	> 6 typ. 6.3	> 32 typ. 38	see Figs 6 and 7

Notes

1. V_{CC} during pulse.



Substrate: Teflon fibre glass
Thickness: 0.4 mm
ϵ_r = 2.54
Dimensions in mm

Fig.3 Broadband test circuit.

NPN silicon planar epitaxial microwave power transistor

RZ2731B48W

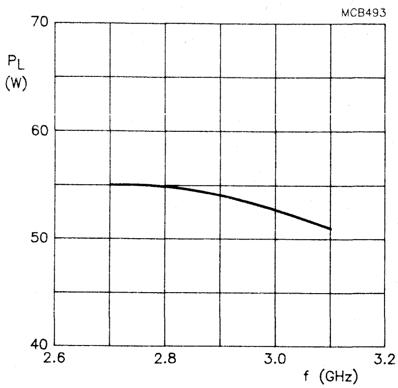


Fig.4 Load power P_L as a function of frequency; V_{CC} = 40 V; t_p = 100 μs; δ = 10%.
(In broadband test circuit as shown in Fig.3).

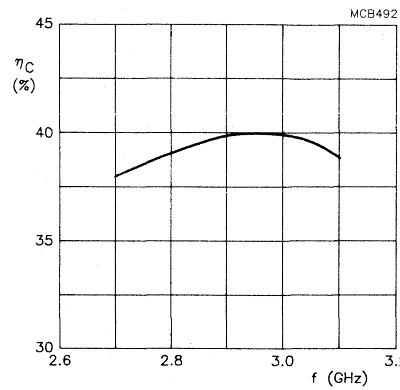


Fig.5 Collector efficiency as a function of frequency.
(In broadband test circuit as shown in Fig.3).

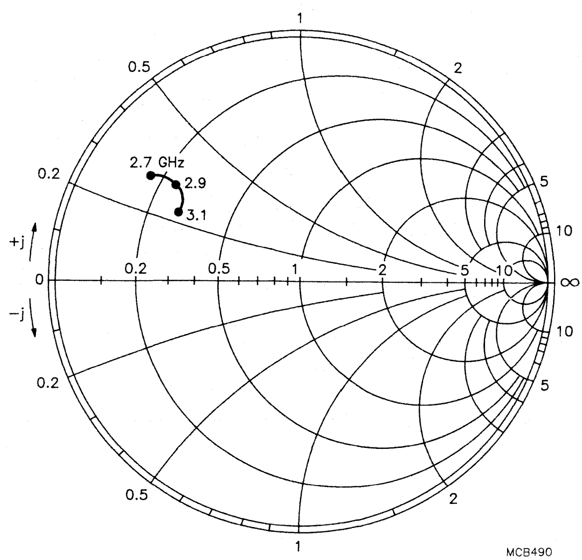


Fig.6 Input impedance as a function of frequency for P_L = 48 W; associated with optimum load impedance; V_{CC} = 40 V; Z_o = 50 Ω.

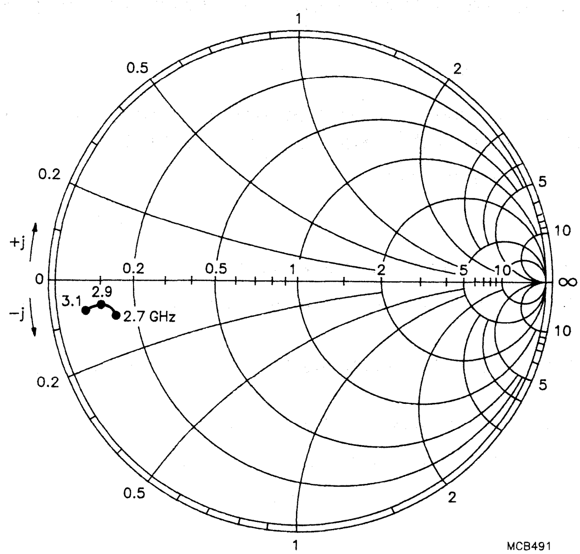


Fig.7 Optimum load impedance as a function of frequency for P_L = 48 W; associated with input impedance; V_{CC} = 40 V; Z_o = 50 Ω.

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 °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 %	$\overline{z_i}$; $\overline{Z_L}$ Ω
class-C t_p = 100 μs δ = 10%	2.7 to 3.1	40	⩾ 60	⩾ 6	⩾ 35	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.

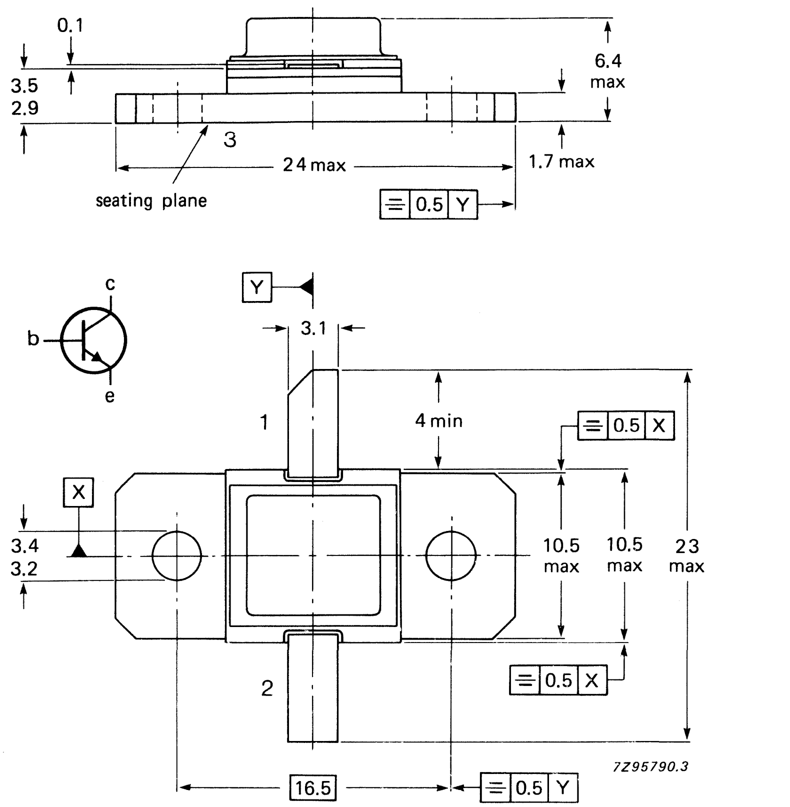
MECHANICAL DATA

Dimensions in mm

Fig. 1 FO-57D.

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				
→ $R_{BE} = 0$	V_{CES}	max.	50	V
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 $T_{mb} \leqslant 75\ ^oC$*	P_{tot}	max.	125	W
Storage temperature range	T_{stg}		−65 to + 200	^oC
Junction temperature	T_j	max.	200	^oC
→ Soldering temperature up to 0.2 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235	^oC

* Maximum value under normal pulsed microwave operating conditions.

THERMAL RESISTANCE (at T_j = 100 °C)

From junction to mounting base (CW)	$R_{th\ j\text{-}mb}$	max.	2.5 K/W
Equivalent thermal impedance under pulsed microwave conditions t_p = 100 μs; δ = 10%	$Z_{th\ j\text{-}mb}$	max.	0.8 K/W ←
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.3 K/W ←

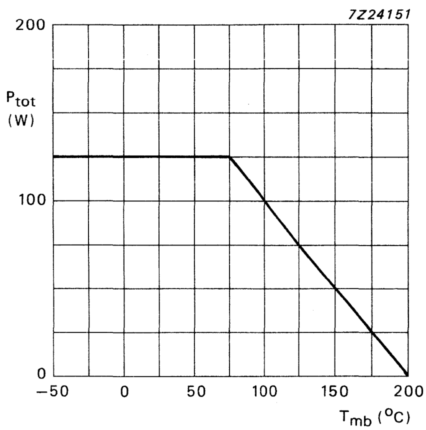


Fig. 2 Power derating curve; t_p = 100 μs; δ = 10%.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off current			
V_{CB} = 50 V; I_E = 0	I_{CBO}	max.	24 mA ←
V_{CB} = 30 V; I_E = 0	I_{CBO}	max.	80 μA ←
V_{CB} = 50 V; R_{BE} = 0	I_{CES}	max.	24 mA ←
Emitter cut-off current			
V_{EB} = 3.5 V; I_C = 0	I_{EBO}	max.	5 mA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °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 μs δ = 10%	2.7 to 3.1	40	⩾ 60 typ. 65	⩾ 6.0 typ. 6.3	⩾ 35 typ. 40	see Fig. 6 ←

* During pulse.

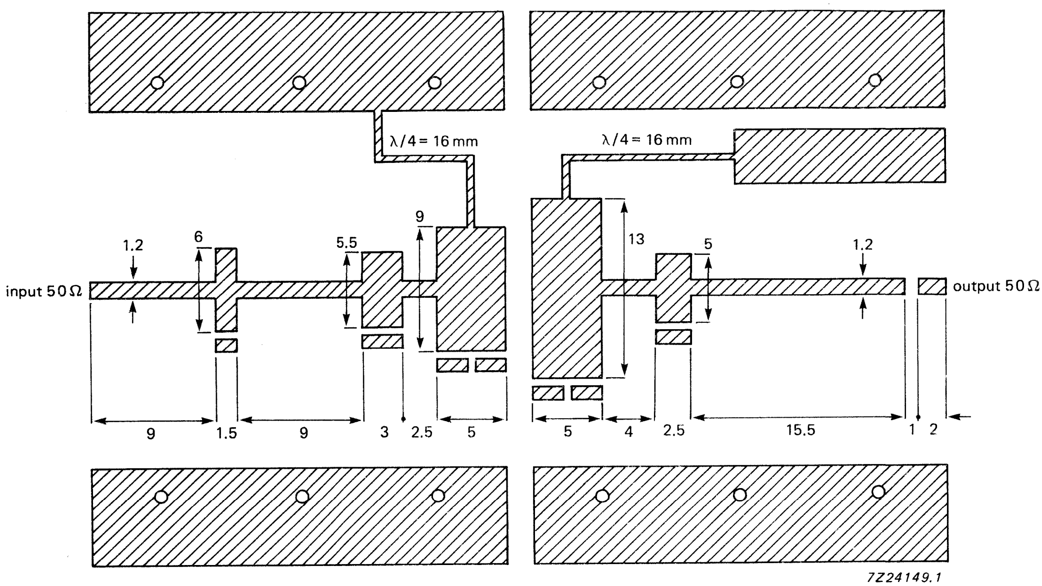


Fig. 3 Broadband test circuit for 2.7 to 3.1 GHz. (dimensions in mm).
PTFE fibreglass printed circuit board, thickness 0.4 mm; ϵ_r = 2.54.

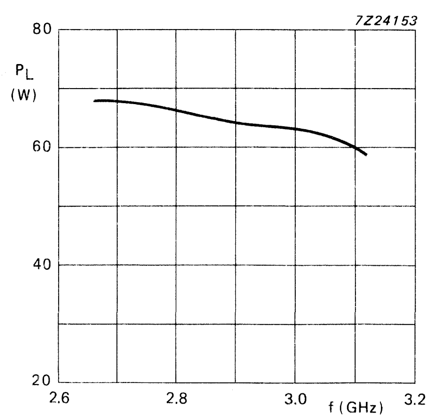


Fig. 4 Load power as a function of frequency*; V_{CC} = 40 V;
P_{in} = 15 W; t_p = 100 μs; δ = 10%; typical values.

* In a broadband test circuit as shown in Fig. 3.

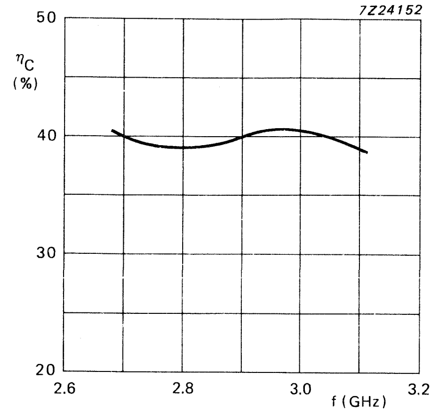


Fig. 5 Collector efficiency as a function of frequency*;
V_{CC} = 40 V; P_{in} = 15 W; t_p = 100 μs; δ = 10%;
typical values.

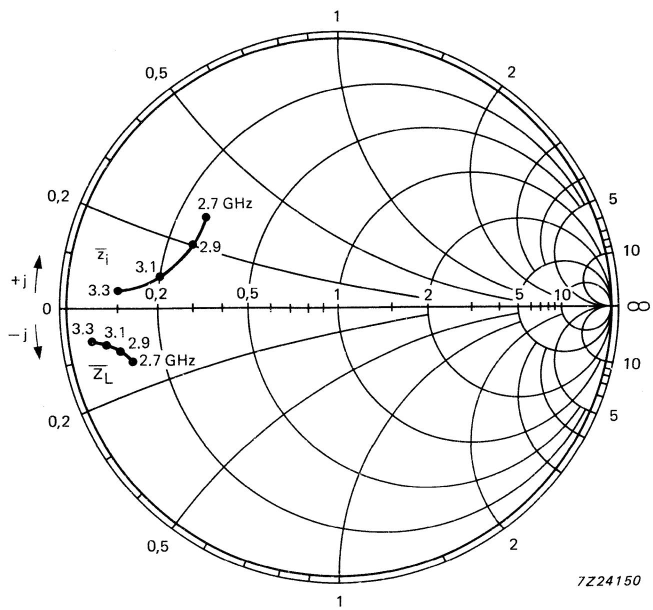


Fig. 6 Input and optimum load impedance as a function of frequency;
Z_O = 50 Ω; V_{CC} = 40 V; typical values.

* In a broadband test circuit as shown in Fig. 3.

Philips Components

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 °C in a common base class C broadband amplifier.

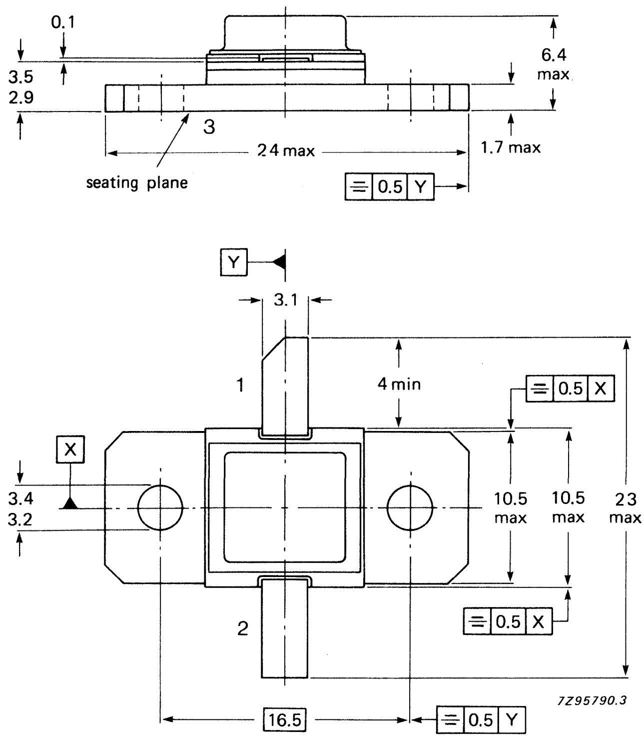
MODE OF OPERATION	f (GHz)	V_{CC} (V)	P_L (W)	G_p (dB)	η_C (%)
class C; t_p = 100 μs; δ = 10%	3.1 to 3.5	40	≥ 13	≥ 5.5	≥ 30

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.

MECHANICAL DATA

Dimensions in mm



Base is connected to seating plane.

Fig.1 FO-57D.

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	$T_{mb} = 75\ °C$; $t_p = 100\ \mu s$; $\delta = 10\%$; note 1	–	35	W
T_{stg}	storage temperature range		−65	200	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leqslant 10$ s; up to 0.2 mm from ceramic	–	235	°C

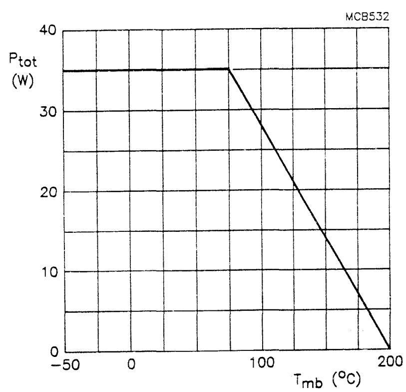


Fig.2 Maximum power dissipation derating as a function of mounting base temperature; $t_p = 100\ \mu s$; $\delta = 10\%$; P_{tot} max = 35 W.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	CW	6.5	K/W
$R_{th\ mb\text{-}h}$	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 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 40 V; I_E = 0	300	μA
I_{CES}	collector cut-off current	V_{CE} = 40 V; R_{BE} = 0 Ω	1	mA
I_{CEO}	collector cut-off current	V_{CE} = 15 V; I_B = 0	1	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	25	μA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C; working in class C broadband mode in pulse (t_p = 100 μs; δ = 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 μs; δ = 10%	3.1 to 3.5	40	> 13 typ. 14	> 5.5 typ. 5.7	> 30 typ. 34	see Figs 5 and 6

Notes

1. V_{CC} during pulse.

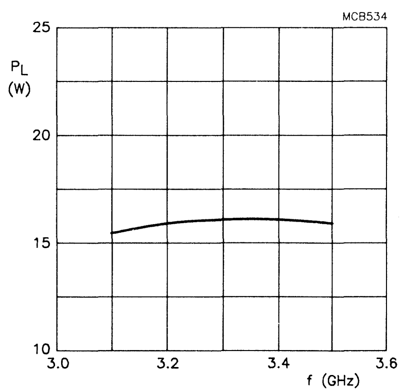


Fig.3 Load power P_L as a function of frequency; V_{CC} = 40 V; t_p = 100 μs; δ = 10%.

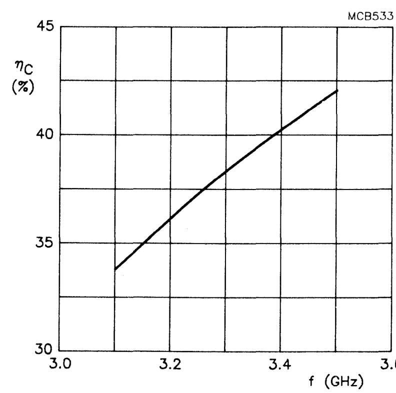


Fig.4 Collector efficiency as a function of frequency.

NPN silicon planar epitaxial microwave power transistor

RZ3135B14W

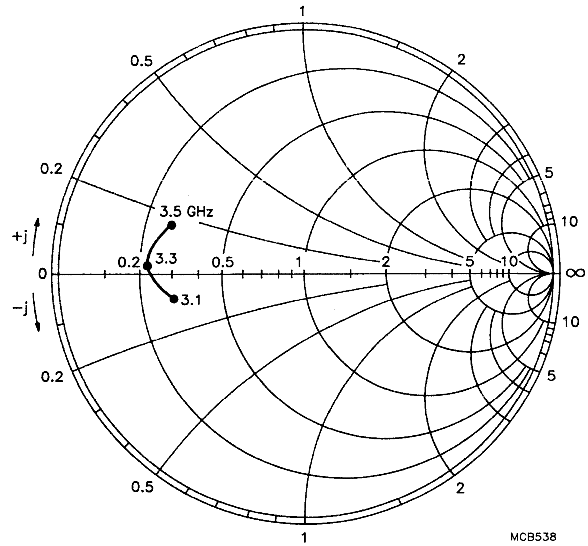


Fig.5 Input impedance as a function of frequency for P_L = 14 W; associated with optimum load impedance; V_{CC} = 40 V; Z_o = 50 Ω.

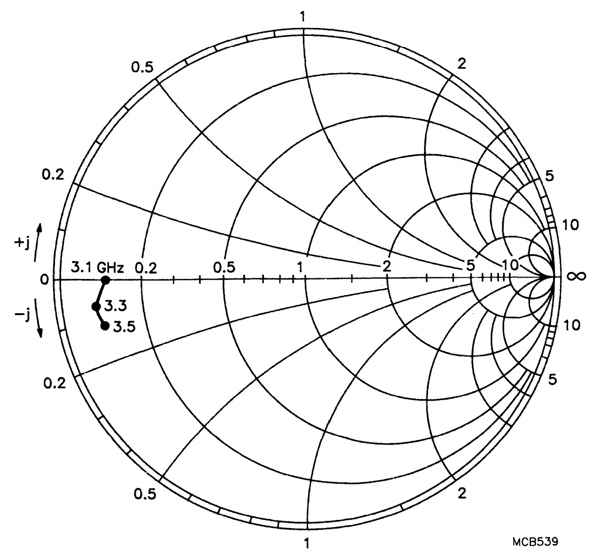


Fig.6 Optimum load impedance as a function of frequency for P_L = 14 W; associated with input impedance; V_{CC} = 40 V; Z_o = 50 Ω.

Philips Components

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 °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 μs; δ = 10%	3.1 to 3.5	40	> 27	> 5.5	> 30

WARNING

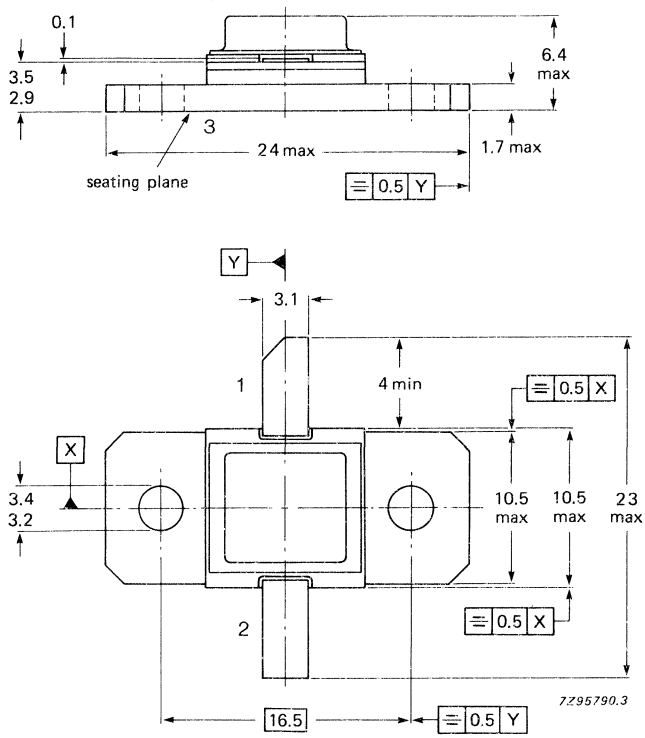
Product and environmental safety — toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose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

Dimensions in mm



Base is connected to seating plane.

Fig.1 FO-57D.

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	$T_{mb} = 75\ °C$; $t_p = 100\ \mu s$; $\delta = 10\%$; note 1	–	70	W
T_{stg}	storage temperature range		−65	200	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leqslant 10$ s: up to 0.2 mm from ceramic	–	235	°C

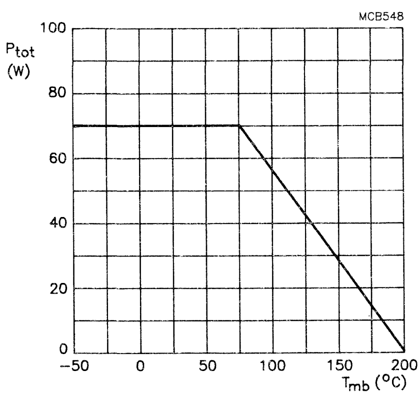


Fig.2 Maximum power dissipation derating as a function of mounting base temperature; $t_p = 100\ \mu s$; $\delta = 10\%$; P_{tot} max = 70 W.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	CW	3.8	K/W
$R_{th\ mb\text{-}h}$	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 ($t_p = 100\ \mu s$; $\delta = 10\%$).

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 40 V; I_E = 0	600	μA
I_{CES}	collector cut-off current	V_{CE} = 40 V; R_{BE} = 0 Ω	2	mA
I_{CEO}	collector cut-off current	V_{CE} = 15 V; I_B = 0	2	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	50	μA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C; working in class C broadband mode in pulse (t_p = 100 μs; δ = 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 μs; δ = 10%	3.1 to 3.5	40	> 27 typ. 28	> 5.5 typ. 5.7	> 30 typ. 34	see Figs 5 and 6

Notes

1. V_{CC} during pulse.

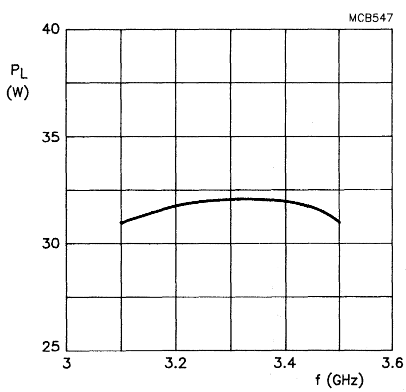


Fig.3 Load power P_L as a function of frequency; V_{CC} = 40 V; t_p = 100 μs; δ = 10%.

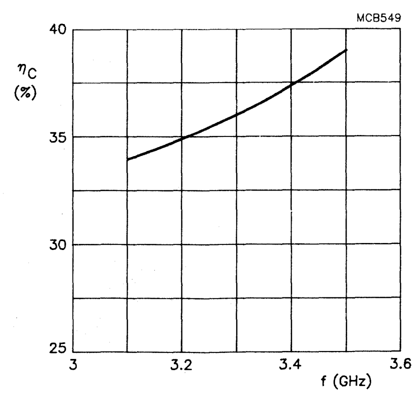


Fig.4 Collector efficiency as a function of frequency.

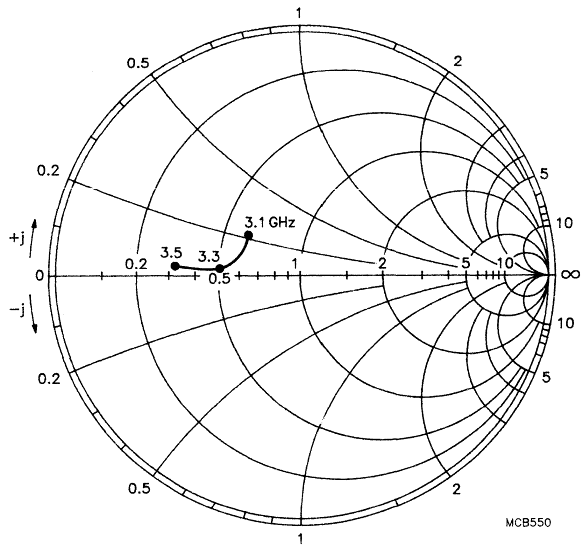


Fig.5 Input impedance as a function of frequency for P_L = 28 W; associated with optimum load impedance; V_{CC} = 40 V; Z_o = 50 Ω.

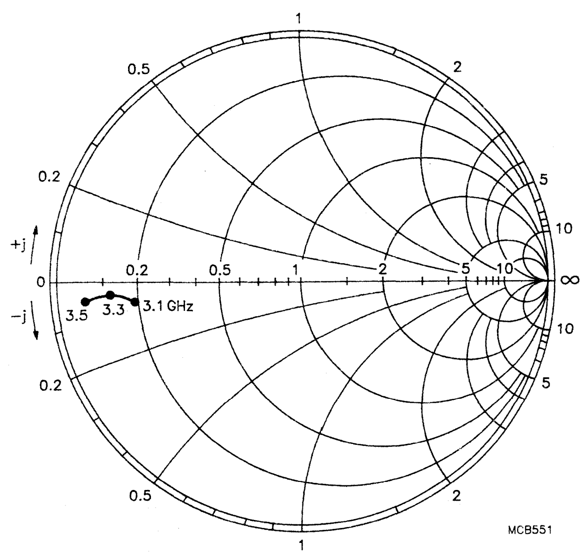


Fig.6 Optimum load impedance as a function of frequency for P_L = 28 W; associated with input impedance; V_{CC} = 40 V; Z_o = 50 Ω.

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 °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 μs; δ = 10%	3.1 to 3.5	40	$\geq$ 40	$\geq$ 5.5	$\geq$ 30

WARNING

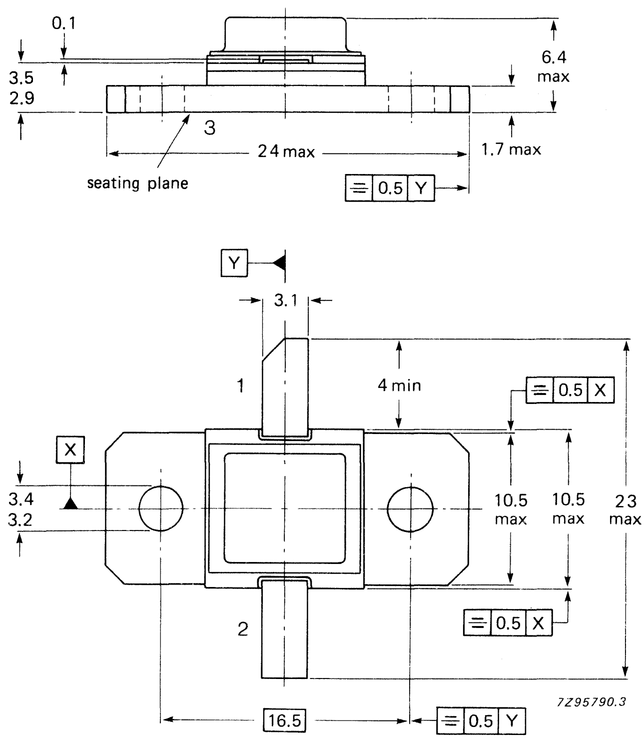
Product and environmental safety — toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose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

Dimensions in mm



Base is connected to seating plane.

Fig.1 FO-57D.

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	$T_{mb} = 75\ °C$; $t_p = 100\ \mu s$; $\delta = 10\%$; note 1	–	100	W
T_{stg}	storage temperature range		−65	200	°C
T_j	operating junction temperature		–	200	°C
T_{sld}	soldering temperature	$t \leq 10$ s; up to 0.2 mm from ceramic	–	235	°C

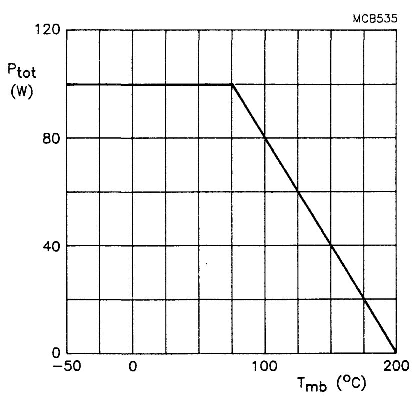


Fig.2 Maximum power dissipation derating as a function of mounting base temperature; $t_p = 100\ \mu s$; $\delta = 10\%$; P_{tot} max = 100 W.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	CW	2.8	K/W
$R_{th\ mb\text{-}h}$	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 °C unless otherwise specified

SYMBOL	PARAMETER	CONDITIONS	MAX.	UNIT
I_{CBO}	collector cut-off current	V_{CB} = 40 V; I_E = 0	900	µA
I_{CES}	collector cut-off current	V_{CE} = 40 V; R_{BE} = 0 Ω	3	mA
I_{CEO}	collector cut-off current	V_{CE} = 15 V; I_B = 0	3	mA
I_{EBO}	emitter cut-off current	V_{EB} = 1.5 V; I_C = 0	75	µA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °C; working in class C broadband mode in pulse (t_p = 100 µs; δ = 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 µs; δ = 10%	3.1 to 3.5	40	40 typ. 42	5.5 typ. 5.7	30 typ. 34	see Figs 5 and 6

Notes

1. V_{CC} during pulse.

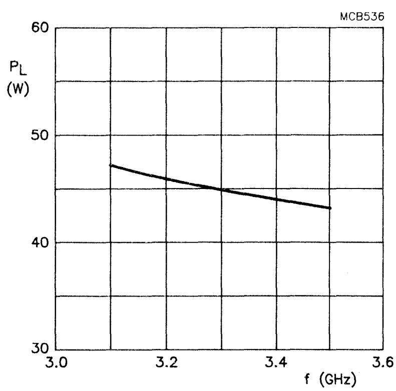


Fig.3 Load power P_L as a function of frequency; V_{CC} = 40 V; t_p = 100 µs; δ = 10%.

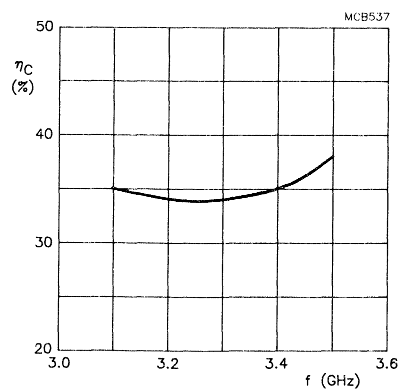


Fig.4 Collector efficiency as a function of frequency.

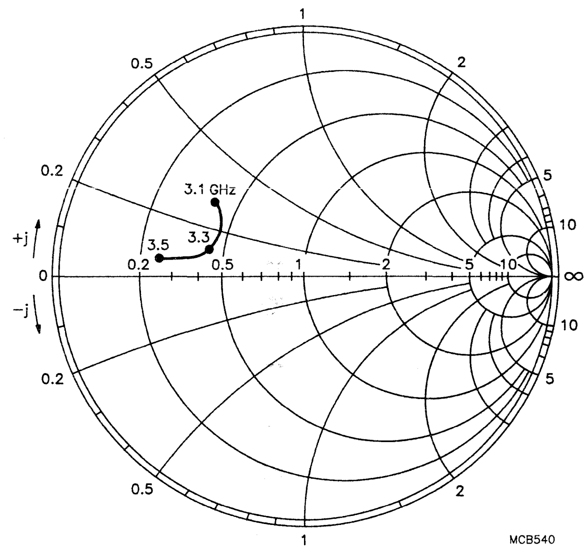


Fig.5 Input impedance as a function of frequency for P_L = 42 W; associated with optimum load impedance; V_{CC} = 40 V; Z_o = 50 Ω.

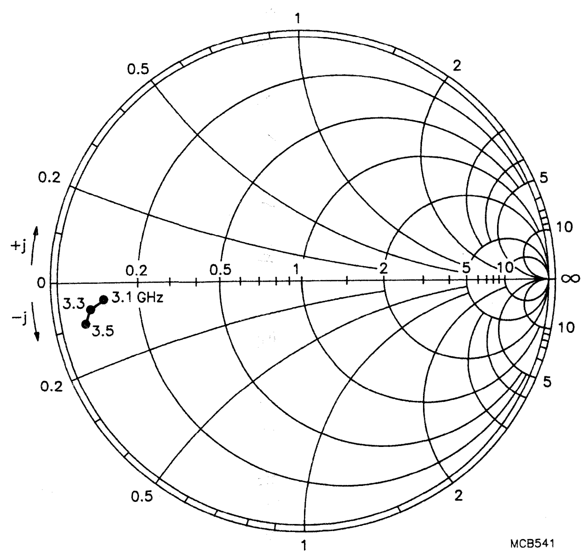


Fig.6 Optimum load impedance as a function of frequency for P_L = 42 W; associated with input impedance; V_{CC} = 40 V; Z_o = 50 Ω.

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 °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 µs δ = 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.

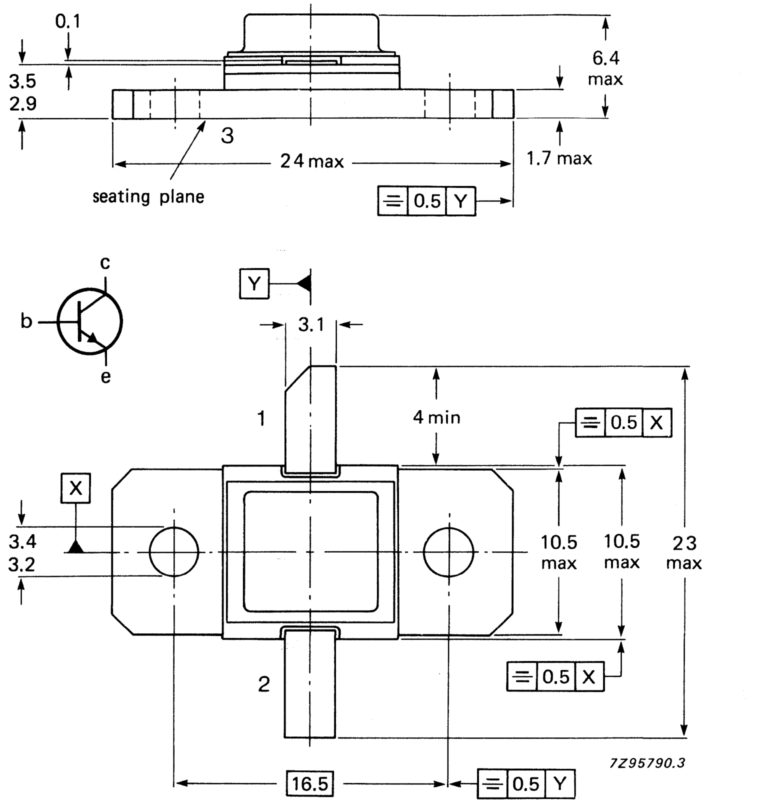
MECHANICAL DATA

Dimensions in mm

Fig. 1 FO-57D.

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			
→ $R_{BE} = 0$	V_{CES}	max.	50 V
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 $T_{mb} \leqslant 75$ °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; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 °C

* Maximum value under normal pulsed microwave operating conditions.

THERMAL RESISTANCE (at T_j = 100 °C)

From junction to mounting base (CW)	$R_{th\ j\text{-}mb}$	max.	2.5 K/W
Equivalent thermal impedance under pulsed microwave conditions t_p = 100 µs; δ = 10%	$Z_{th\ j\text{-}mb}$	max.	0.8 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.3 K/W

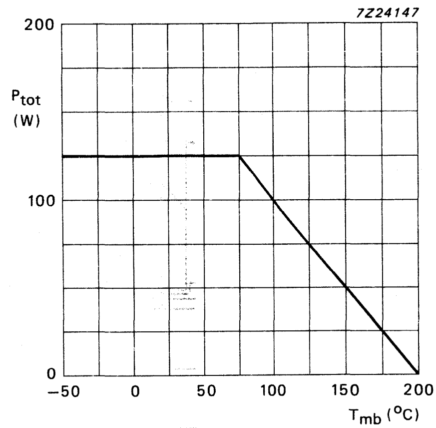


Fig. 2 Power derating curve; t_p = 100 µs; δ = 10%.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector cut-off current			
V_{CB} = 50 V; I_E = 0	I_{CBO}	max.	24 mA
V_{CB} = 30 V; I_E = 0	I_{CBO}	max.	80 µA
V_{CB} = 50 V; R_{BE} = 0	I_{CES}	max.	24 mA ←
Emitter cut-off current			
V_{EB} = 3.5 V; I_C = 0	I_{EBO}	max.	5 mA

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °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 µs δ = 10%	3,1 to 3,5	40	⩾ 50 typ. 55	⩾ 5.2 typ. 5.6	⩾ 30 typ. 35	see Fig. 6 ←

* During pulse.

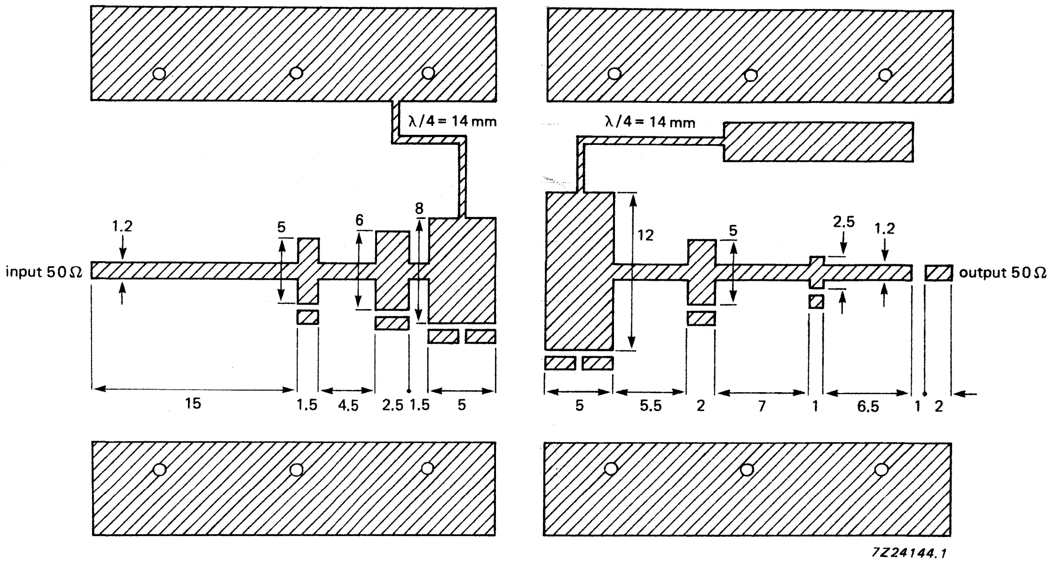


Fig. 3 Broadband test circuit for 3.1 to 3.5 GHz. (dimensions in mm).
PTFE fibreglass printed circuit board, thickness 0.4 mm; ϵ_r = 2.54.

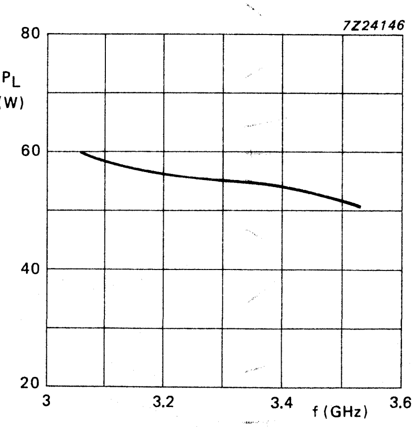


Fig. 4 Load power as a function of frequency*; V_{CC} = 40 V;
P_{in} = 15 W; t_p = 100 μs; δ = 10%; typical values.

* In a broadband test circuit as shown in Fig. 3.

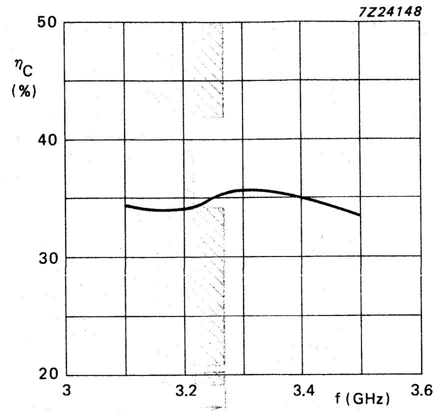


Fig. 5 Collector efficiency as a function of frequency*; V_{CC} = 40 V; t_p = 100 μs; δ = 10%; typical values.

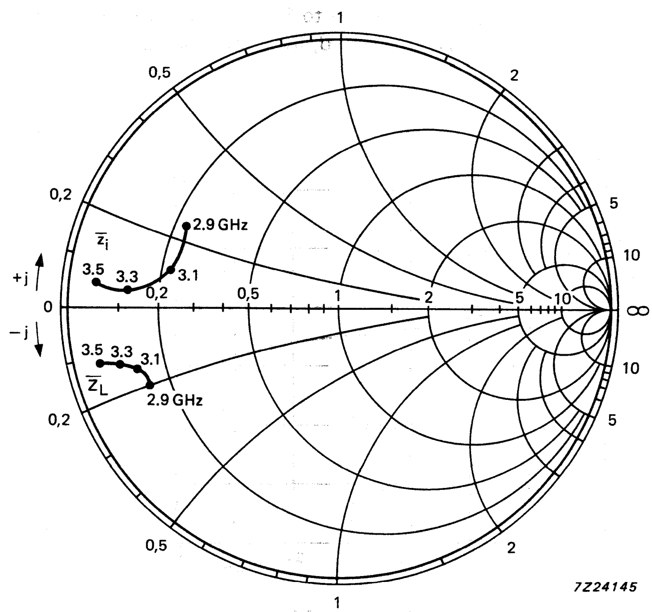


Fig. 6 Input and optimum load impedance as a function of frequency; Z_O = 50 Ω; V_{CC} = 40 V; typical values.

* 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 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 °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 %
t_p = 100 μs; δ = 10%	1.09	50	≥ 35	≥ 7	≥ 30

MECHANICAL DATA

Dimensions in mm

FO-57C (see Fig. 1)

WARNING

Product and environmental safety — toxic materials

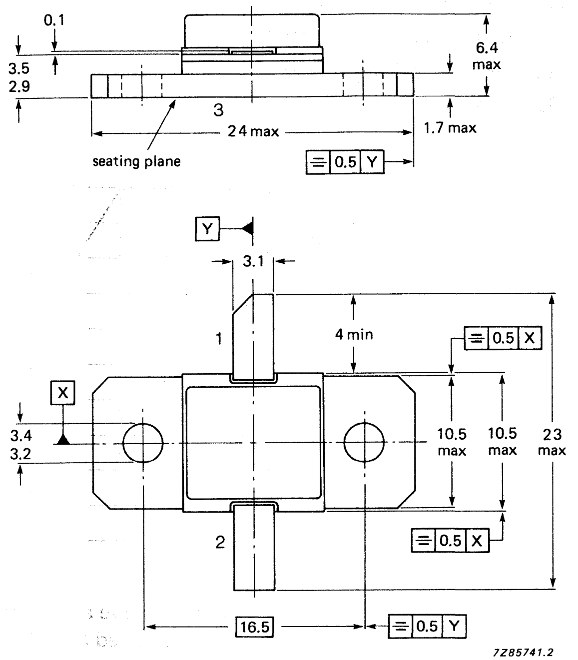
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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

Dimensions in mm

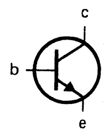
Fig. 1 FO-57C.



Base is connected
to the seating plane

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) $t_p = 100\ \mu s$; $\delta \leqslant 10\%$	I_C	max.	3 A
Total power dissipation up to $T_{mb} = 75\ ^oC$; $t_p = 100\ \mu s$; $\delta \leqslant 10\%$	P_{tot}	max.	125 W
Storage temperature range	T_{stg}		−65 to +200 ^oC
Junction temperature	T_j	max.	200 ^oC
Soldering temperature up to 0.2 mm from the case; $t_{sld} \leqslant 10$ s	T_{sld}	max.	235 ^oC

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to mounting base	$R_{th\,j\text{-}mb}$	max.	5.0 K/W
From mounting base to heatsink	$R_{th\,mb\text{-}h}$	max.	0.2 K/W ←
Equivalent thermal impedance t_p = 100 μs; δ = 10%	Z_{th}	max.	1.0 K/W ←

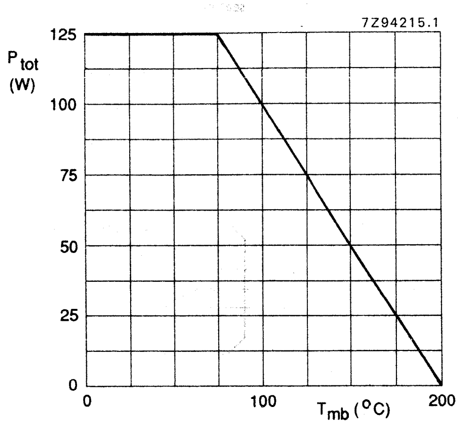


Fig. 2 Power derating curve as a function of base temperature; t_p = 100 μs; δ = 10%; pulsed conditions.

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Collector-base breakdown voltage I_C = 20 mA; I_E = 0	$V_{(BR)CBO}$	min.	65 V ←
Collector-emitter breakdown voltage I_C = 20 mA; R_{BE} = 0	$V_{(BR)CES}$	min.	60 V ←
Emitter-base breakdown voltage I_C = 0; I_E = 3 mA	$V_{(BR)EBO}$	min.	3 V ←
Collector cut-off current I_E = 0; V_{CB} = 50 V	I_{CBO}	max.	2 mA ←

APPLICATION INFORMATION

Microwave performance up to T_{mb} = 25 °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	⩾ 35 typ. 50	⩾ 7 typ. 10	⩾ 30 typ. 45

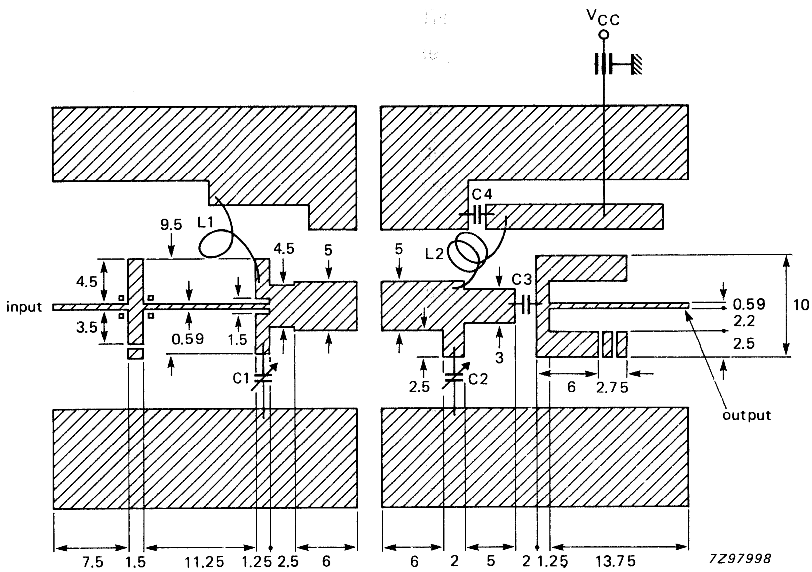


Fig. 3 Narrowband test circuit for 1.09 GHz. (dimensions in mm).
Epsilam printed circuit board; thickness = 0.635 mm; ϵ_r = 10.

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 °C in a common-base class-C narrowband amplifier. 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 μs, δ = 10%	1.09	50	⩾80	⩾7	⩾30	see table

MECHANICAL DATA

FO-57C (see Fig.1)

WARNING

Product and environmental safety — toxic materials

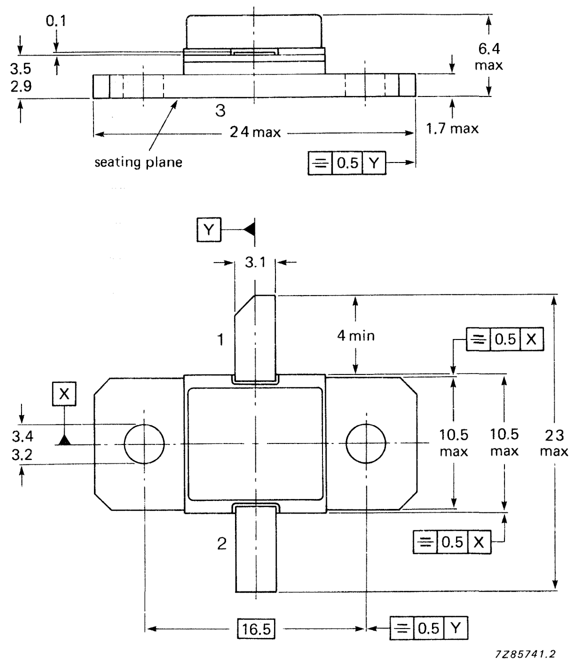
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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

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.	6	A
Total power dissipation up to $T_{mb} = 75\ ^oC$ $t_p = 100\ \mu s$, $\delta \leq 10\%$	P_{tot}	max.	225	W
Storage temperature	T_{stg}		−65 to +200	^oC
Junction temperature	T_j	max.	200	^oC
Soldering temperature at 0.2 mm from the case, $t_{sld} \leq 10$ s	T_{sld}	max.	235	^oC

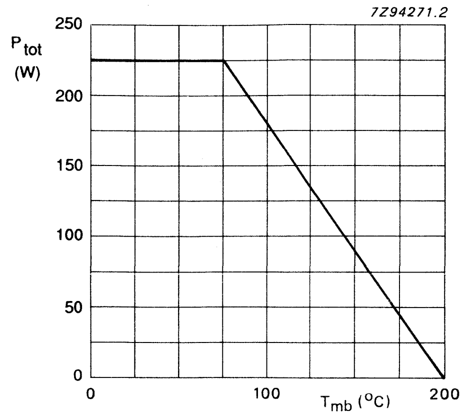


Fig.2 Power derating curve as a function of mounting base temperature; t_p = 100 μs, δ = 10%.

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	2.5 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2 K/W
Equivalent thermal impedance; t_p = 100 μs; δ = 10%	Z_{th}	max.	0.55 K/W

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Breakdown voltages			
I_C = 40 mA; I_E = 0	$V_{(BR)CBO}$	min.	65 V
I_C = 40 mA; R_{BE} = 0	$V_{(BR)CES}$	min.	60 V
I_C = 0; I_E = 6 mA	$V_{(BR)EBO}$	min.	3 V
Collector cut-off current			
I_E = 0; V_{CB} = 50 V	I_{CBO}	max.	4 mA

IMPEDANCES

frequency GHz	input ($\overline{z_i}$) Ω	load ($\overline{Z_L}$) 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 °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

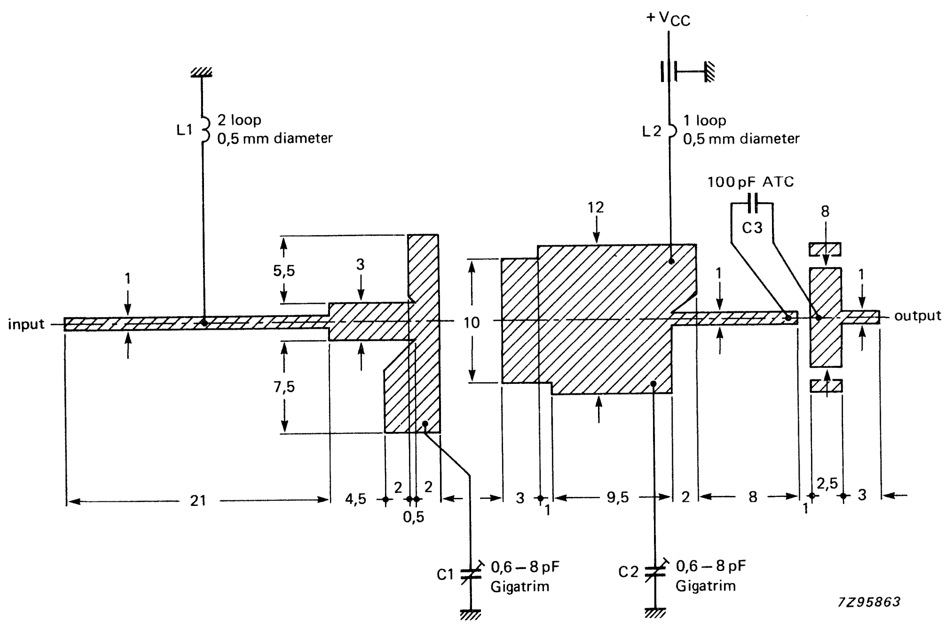


Fig.3 Narrowband test circuit for 1.09 GHz (dimensions in mm).
Epsilam printed-circuit board; thickness 0.635 mm; ϵ_r = 10.

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 ^oC 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 t_p = 100 μs, δ = 10%	1.09	50	⩾ 200	⩾ 7	⩾ 30	see table

MECHANICAL DATA

Dimensions in mm

FO-57C (see Fig. 1)

WARNING

Product and environmental safety — toxic materials

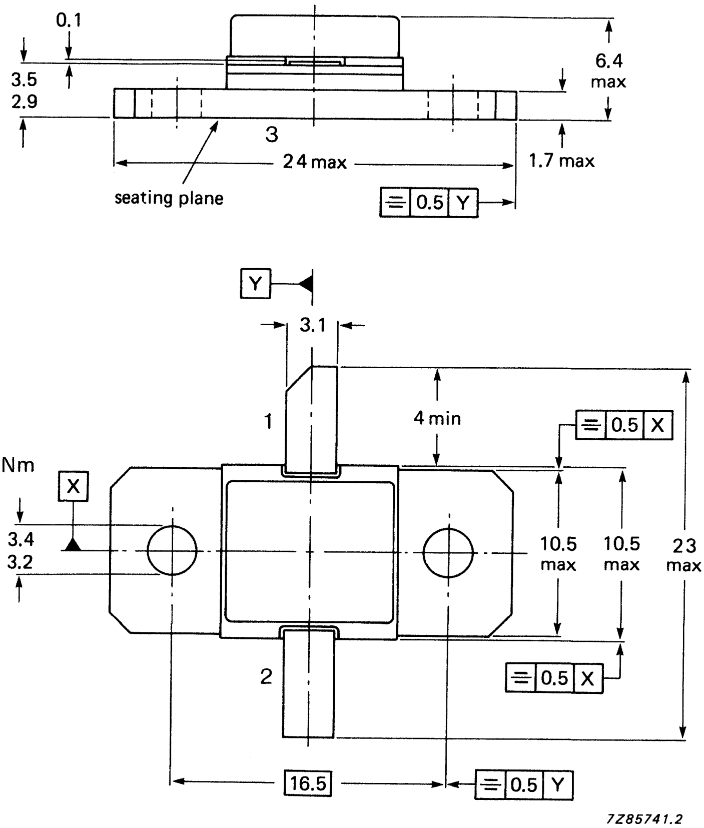
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions.

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

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 = 100 μs, $\delta \leqslant$ 10%	I_C	max.	15 A
Total power dissipation up to T_{mb} = 75 °C			
t_p = 100 μs, $\delta \leqslant$ 10%	P_{tot}	max.	450 W
Storage temperature range	T_{stg}		−65 to +200 °C
Junction temperature	T_j	max.	200 °C
Soldering temperature			
at 0.2 mm from the case. $t_{sld} \leqslant$ 10 s	T_{sld}	max.	235 °C ←

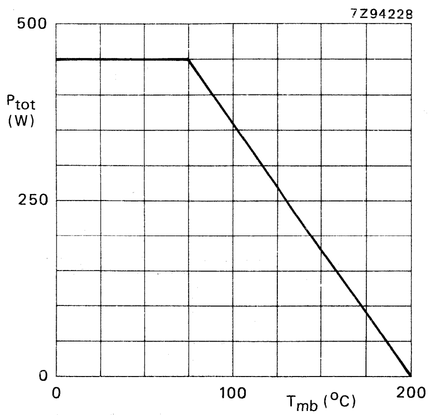


Fig. 2 Power derating curve as a function of mounting base temperature; t_p = 100 μs, δ = 10%.

THERMAL RESISTANCE (at T_j = 75 °C)

From junction to mounting base	$R_{th\ j\text{-}mb}$	max.	1.1 K/W
From mounting base to heatsink	$R_{th\ mb\text{-}h}$	max.	0.2 K/W ←
Equivalent thermal impedance; t_p = 100 μs; δ = 10%	Z_{th}	max.	0.28 K/W ←

CHARACTERISTICS

T_{mb} = 25 °C unless otherwise specified

Breakdown voltages			
I_C = 100 mA; I_E = 0	$V_{(BR)CBO}$	min.	65 V ←
I_C = 100 mA; R_{BE} = 0	$V_{(BR)CES}$	min.	60 V ←
I_C = 0; I_E = 15 mA	$V_{(BR)EBO}$	min.	3 V ←
Collector cut-off current			
I_E = 0; V_{CB} = 50 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 °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	⩾ 200 typ. 250	⩾ 7 typ. 7.5	⩾ 30 typ. 35

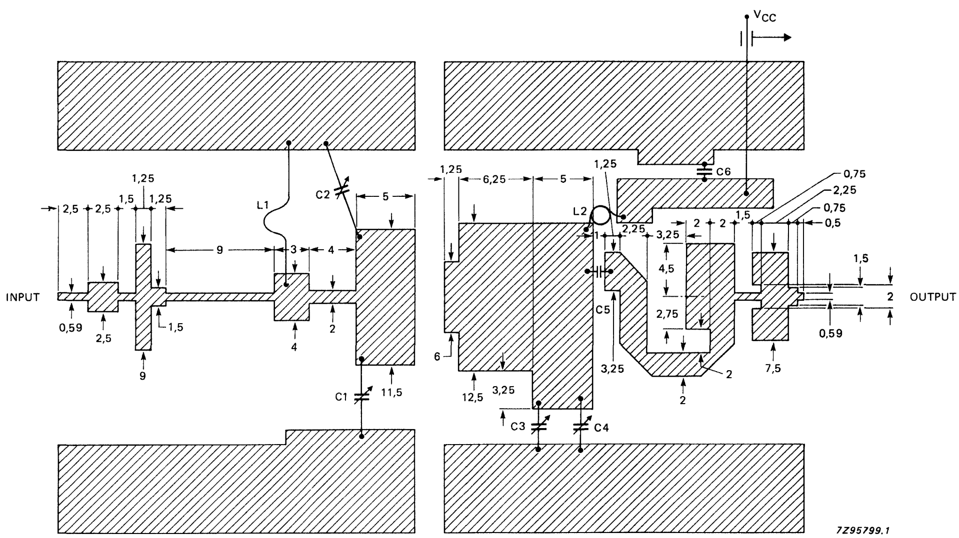


Fig. 3 Narrowband test cicuit for 1,09 GHz (dimensions in mm).
Epsilam printed circuit board; thickness 0.635 mm; ϵ_r = 10.

List of components:

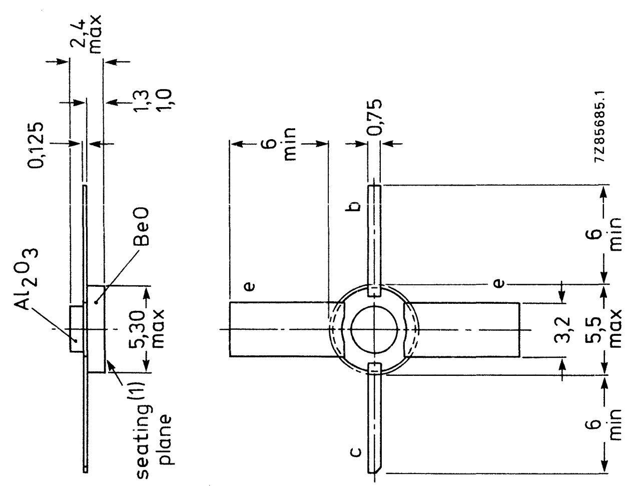
C1 = C3 0.6 - 8 pF Gigatrim capacitor
C2 0.8 - 12.3 pF Gigatrim capacitor
C4 10 pF capacitor
C5 100 pF ATC capacitor
C6 1000 pF decoupling capacitor
L1 Square loop 6 x 6 mm; wire diameter 0.8 mm
L2 One turn diameter 5 mm; wire diameter 0.5 mm

ENVELOPES

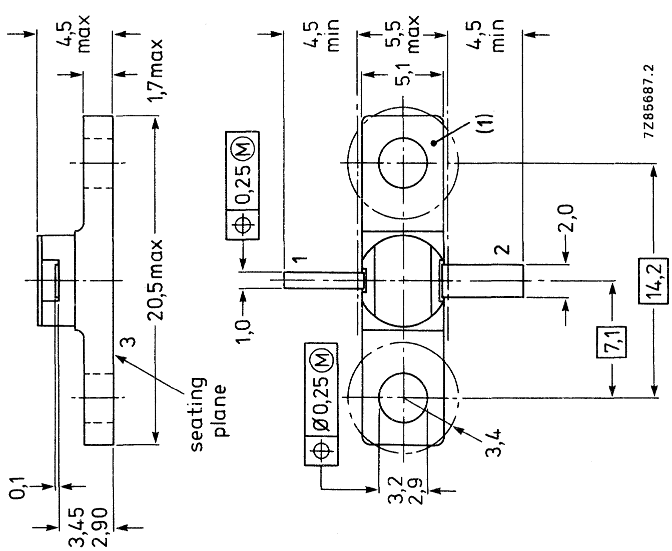
MECHANICAL DATA

Dimensions in mm

FO-45.



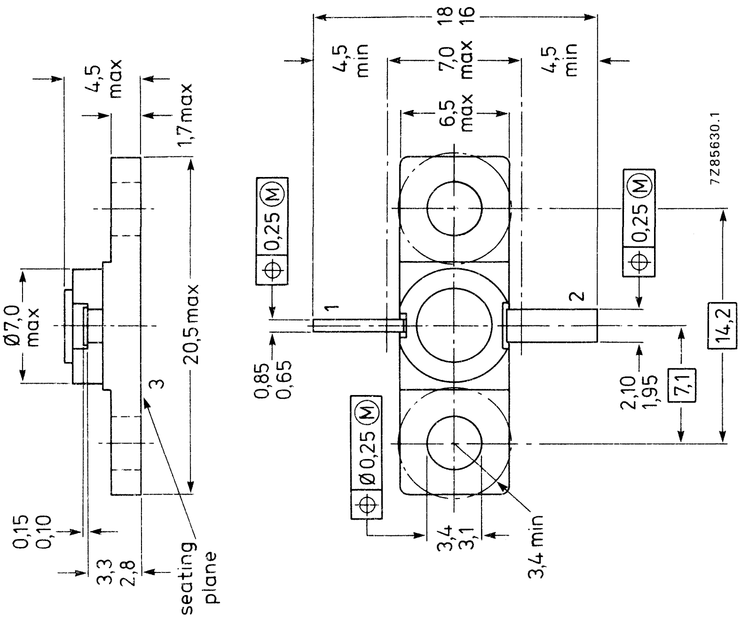
FO-41B.



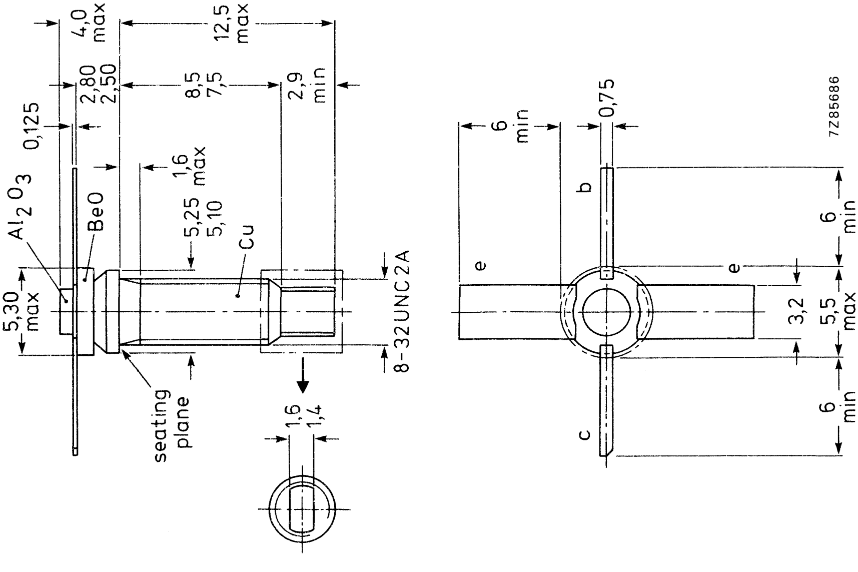
MECHANICAL DATA

Dimensions in mm

FO-53.



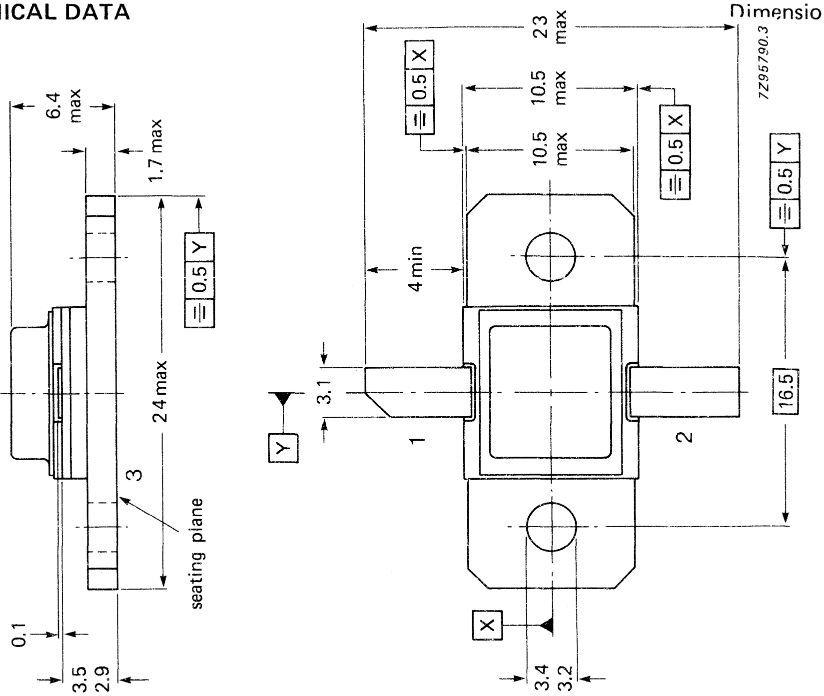
FO-46.



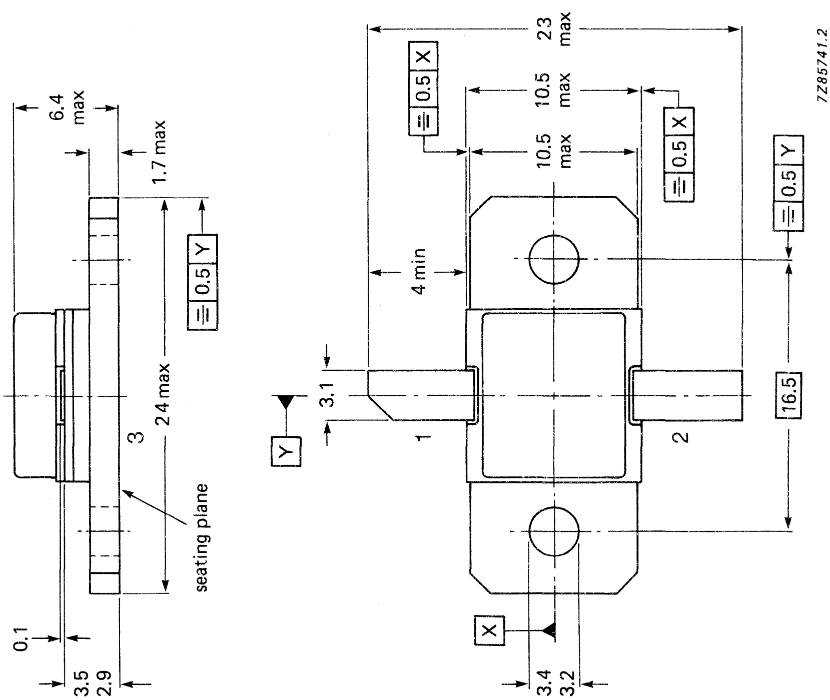
MECHANICAL DATA

Dimensions in mm

FO-57D.



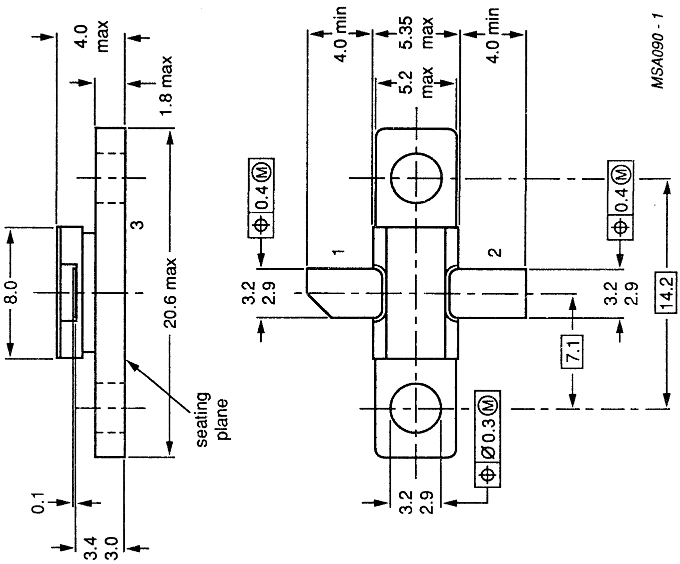
FO-57C.



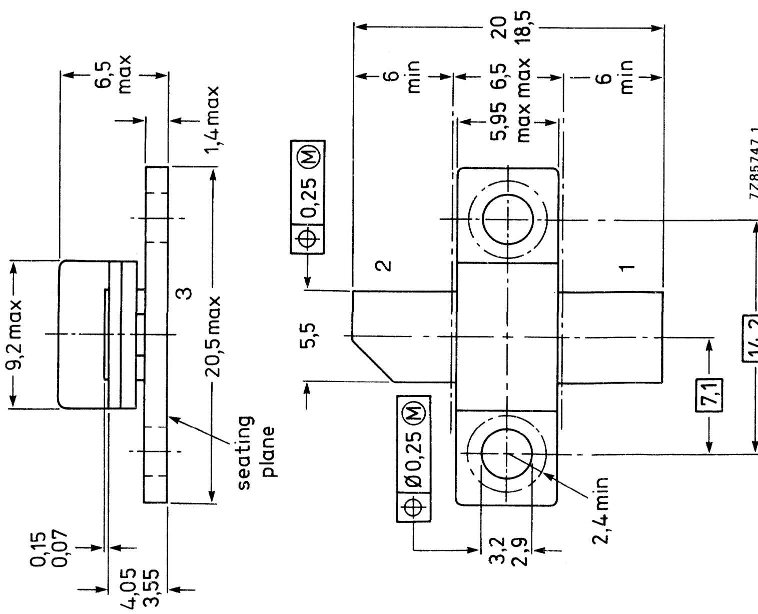
MECHANICAL DATA

Dimensions in mm

FO-83A.



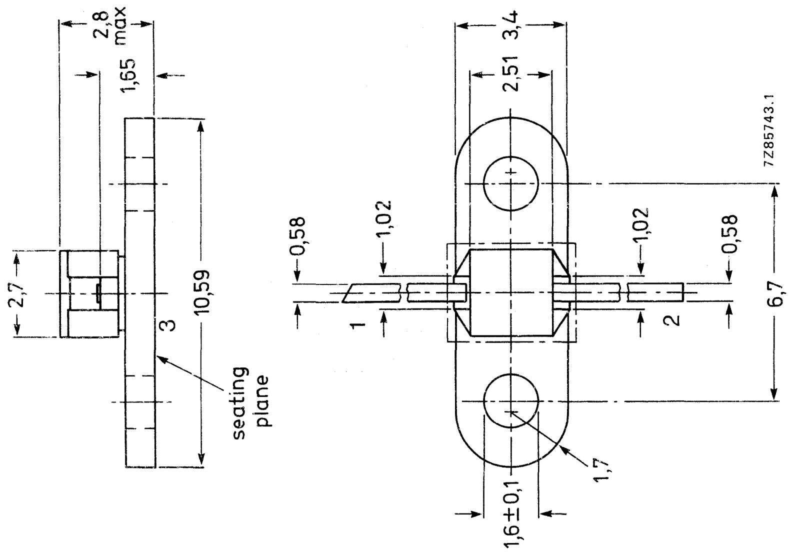
FO-67.



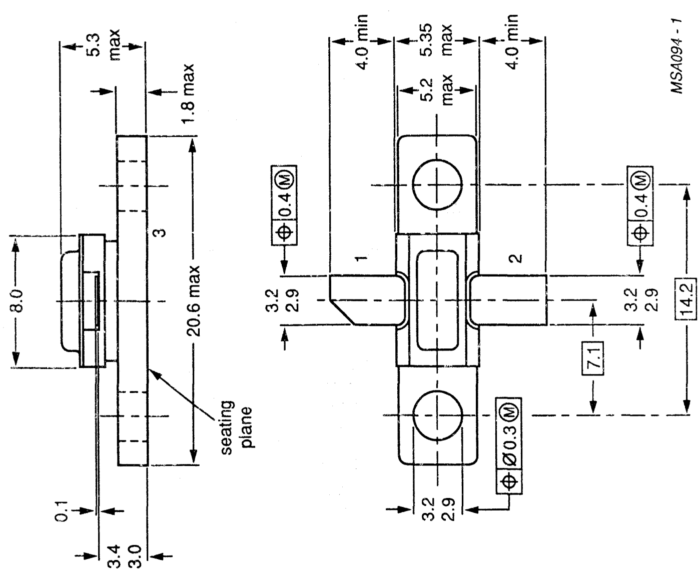
MECHANICAL DATA

Dimensions in mm

FO-85.



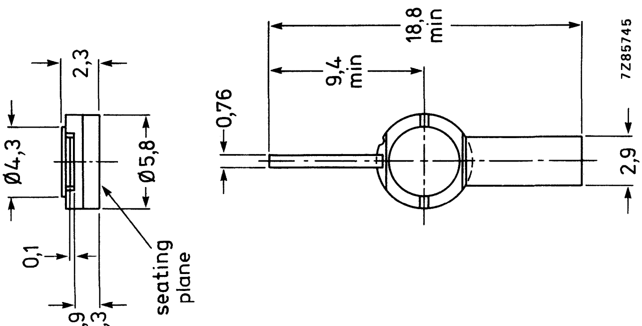
FO-83B.



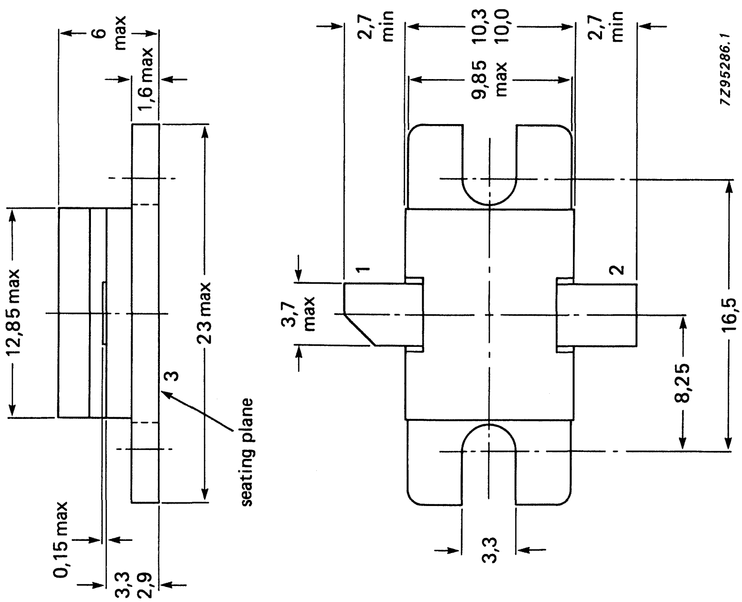
MECHANICAL DATA

Dimensions in mm

FO-93.



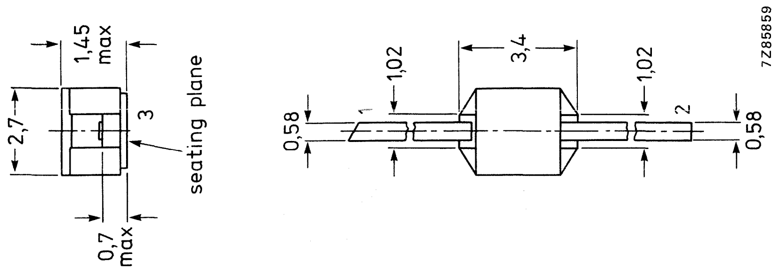
FO-91.



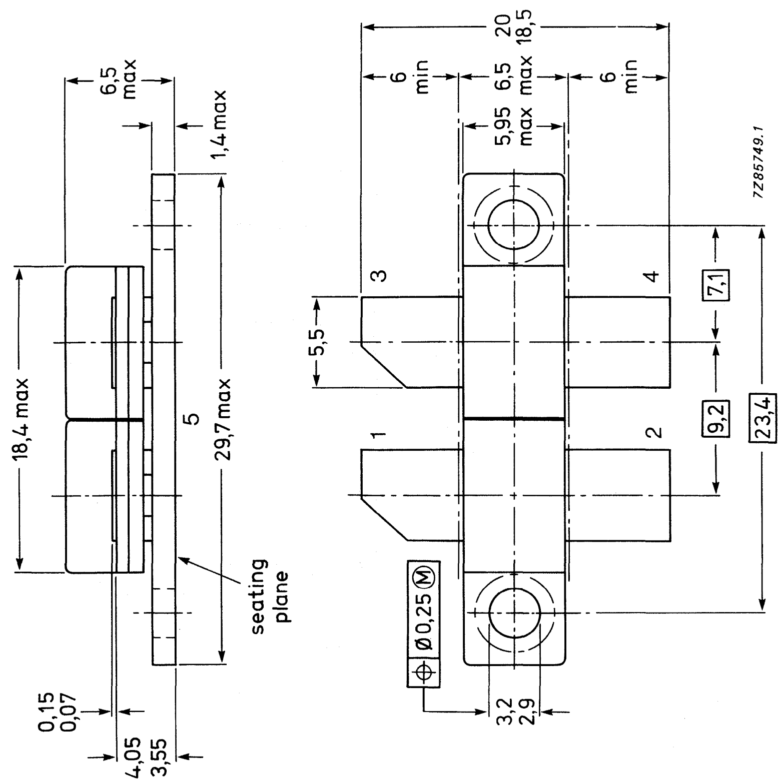
MECHANICAL DATA

Dimensions in mm

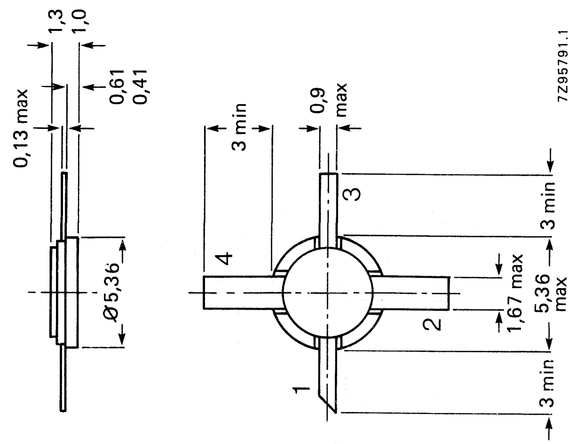
FO-102.



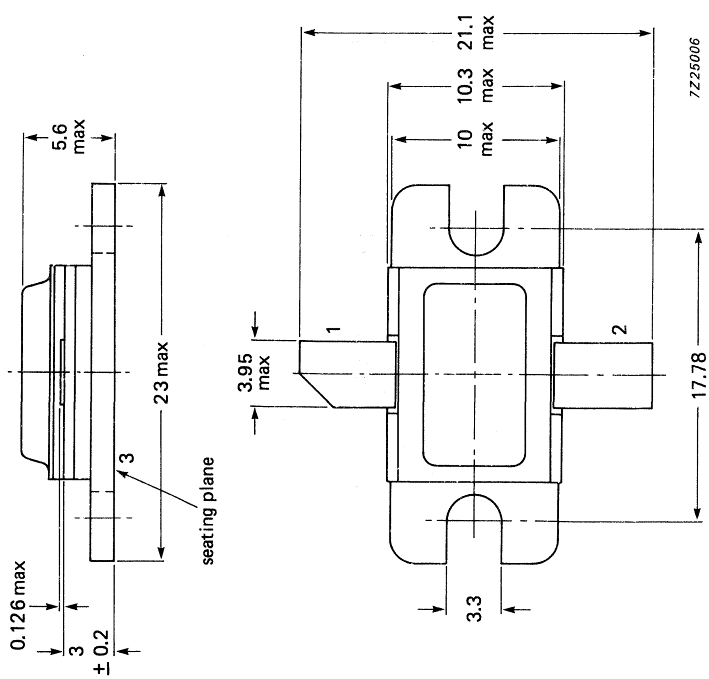
FO-96.



FO-163.



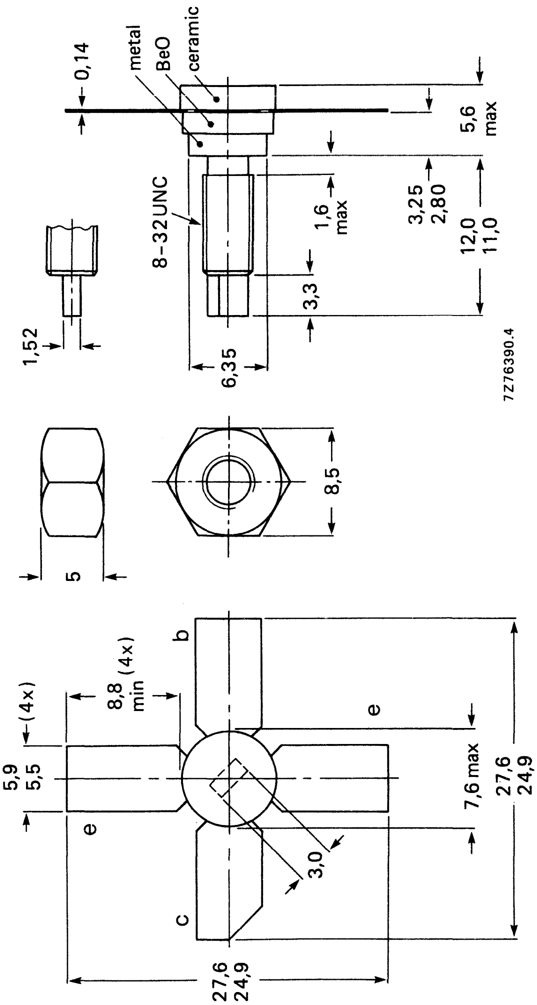
FO-125A.



MECHANICAL DATA

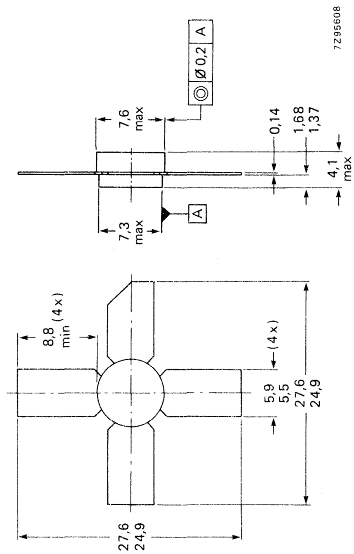
Dimensions in mm

SOT122.

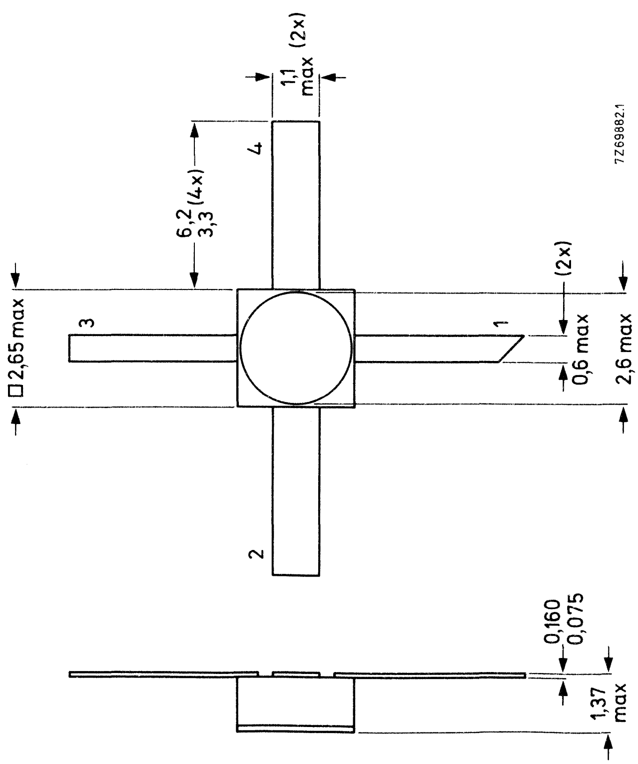


MECHANICAL DATA

SOT-122D.



SOT-100.



INDEX

INDEX OF TYPE NUMBERS

The inclusion of a type number in this publication does not necessarily imply its availability.

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.

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	**I^2C-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** **SC09**	**RF power transistors** **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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