DATA SHEET

BFQ621
NPN 7 GHz wideband transistor

Product specification
Supersedes data of 1995 Apr 11
File under Discrete Semiconductors, SC14

1995 Sep 26

Philips
Semiconductors

PHILIPS

NPN 7 GHz wideband transistor BFQ621

FEATURES

- High power gain
- High output voltage
- High maximum junction temperature
- Gold metallization ensures excellent reliability.

DESCRIPTION

Silicon NPN transistor in a 4-lead dual-emitter SOT172A2 package with a ceramic cap. All leads are isolated from the mounting base. Emitter ballasting resistors and application of gold sandwich metallization ensures an optimum temperature profile and excellent reliability properties.

APPLICATIONS

It is primarily intended for use in MATV and microwave amplifiers, such as aerial amplifiers, radar systems, oscilloscopes, spectrum analyzers, etc.

PINNING

PIN	DESCRIPTION
1	collector
2	emitter
3	base
4	emitter

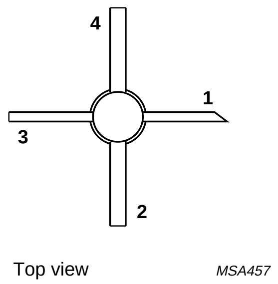


Fig.1 SOT172A2.

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{CEO}	collector-emitter voltage	open base	–	–	16	V
I_C	collector current (DC)		–	–	150	mA
P_{tot}	total power dissipation	up to T_{mb} = 25 °C	–	–	8	W
h_{FE}	DC current gain	I_C = 120 mA; V_{CE} = 18 V; T_{amb} = 25 °C	40	–	–	
f_T	transition frequency	I_C = 120 mA; V_{CE} = 18 V; f = 1 GHz; T_{amb} = 25 °C	–	7	–	GHz
G_{UM}	maximum unilateral power gain	I_C = 120 mA; V_{CE} = 18 V; f = 500 MHz; T_{amb} = 25 °C	–	18.5	–	dB
V_O	output voltage	I_C = 120 mA; V_{CE} = 18 V; $f_{(p+q-r)}$ = 793.25 MHz; d_{im} = –60 dB; R_L = 75 Ω	–	1.2	–	V

WARNING
Product and environmental safety - toxic materials
This product contains beryllium oxide. The product is entirely safe provided that the BeO disc is not damaged. All persons who handle, use or dispose of this product should be aware of its nature and of the necessary safety precautions. After use, dispose of as chemical or special waste according to the regulations applying at the location of the user. It must never be thrown out with the general or domestic waste.

LIMITING VALUES

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CBO}	collector-base voltage	open emitter	–	25	V
V_{CEO}	collector-emitter voltage	open base	–	16	V
V_{EBO}	emitter-base voltage	open collector	–	2	V
I_C	collector current (DC)		–	150	mA
P_{tot}	total power dissipation	up to T_{mb} = 25 °C	–	8	W
T_{stg}	storage temperature		–65	+175	°C
T_j	junction temperature		–	+200	°C

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	CONDITIONS	VALUE	UNIT
$R_{th\ j\text{-}mb}$	thermal resistance from junction to mounting base	P_{tot} = 8 W; up to T_{mb} = 25 °C	21.9	K/W

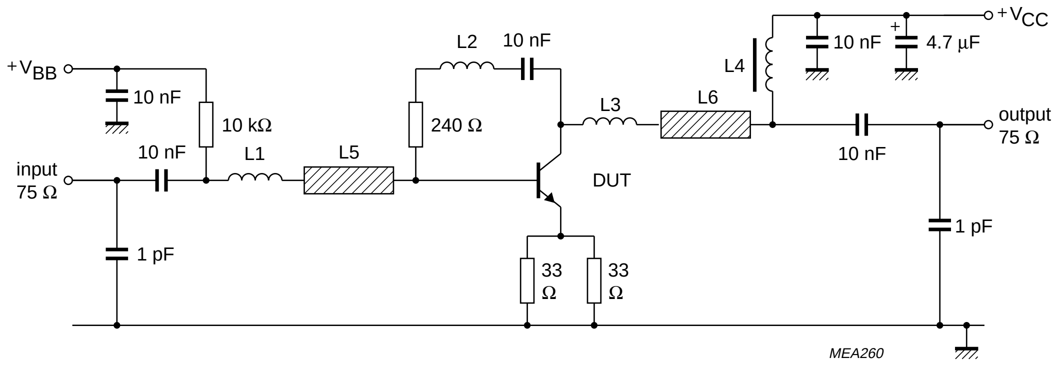
CHARACTERISTICS

T_j = 25 °C (unless otherwise specified).

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	I_C = 0.1 mA; I_E = 0	–	–	25	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	I_C = 10 mA; I_B = 0	–	–	16	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	I_E = 0.1 mA; I_C = 0	–	–	2	V
I_{CBO}	collector-base leakage current	I_E = 0; V_{CB} = 18 V	–	–	100	μA
h_{FE}	DC current gain	I_C = 50 mA; V_{CE} = 10 V	50	–	160	
f_T	transition frequency	I_C = 120 mA; V_{CE} = 18 V; f = 1 GHz; see Fig.3	–	7	–	GHz
C_c	collector capacitance	$I_E = i_e$ = 0; V_{CB} = 18 V; f = 1 MHz	–	1.5	–	pF
C_e	emitter capacitance	$I_C = i_c$ = 0; V_{EB} = 0.5 V; f = 1 MHz	–	5	–	pF
C_{re}	feedback capacitance	I_C = 0; V_{CE} = 18 V; f = 1 MHz; see Fig.4	–	0.85	1.2	pF
G_{UM}	maximum unilateral power gain; note 1	I_C = 120 mA; V_{CE} = 18 V; f = 500 MHz; T_{amb} = 25 °C;	–	18.5	–	dB
		I_C = 120 mA; V_{CE} = 18 V; f = 800 MHz; T_{amb} = 25 °C;	–	14.5	–	dB
V_O	output voltage	note 2	–	1.35	–	V
		note 3	–	1.2	–	V
d_2	second order intermodulation distortion	note 4	–	–60	–	dB
		note 5	–	–60	–	dB

Notes

1. G_{UM} is the maximum unilateral power gain, assuming s_{12} is zero. $G_{UM} = 10 \log \frac{|s_{21}|^2}{(1-|s_{11}|^2)(1-|s_{22}|^2)}$ dB.
2. d_{im} = –60dB (DIN45004B); see Fig.2; I_C = 120 mA; V_{CE} = 18 V; R_L = 75 Ω; T_{amb} = 25 °C;
   $V_p = V_O$; f_p = 445.25 MHz;
   $V_q = V_O$ –6 dB; f_q = 453.25 MHz;
   $V_r = V_O$ –6 dB; f_r = 455.25 MHz;
   measured at $f_{(p+q-r)}$ = 443.25 MHz; see Fig.5.
3. d_{im} = –60dB (DIN45004B); see Fig.2; I_C = 120 mA; V_{CE} = 18 V; R_L = 75 Ω; T_{amb} = 25 °C;
   $V_p = V_O$; f_p = 795.25 MHz;
   $V_q = V_O$ –6 dB; f_q = 803.25 MHz;
   $V_r = V_O$ –6 dB; f_r = 805.25 MHz;
   measured at $f_{(p+q-r)}$ = 793.25 MHz; see Fig.6.
4. V_O = 50 dBmV = 316 mV; I_C = 90 mA; V_{CE} = 18 V; R_L = 75 Ω; T_{amb} = 25 °C;
   measured at $f_{(p+q)}$ = 450 MHz; see Fig.7.
5. V_O = 50 dBmV = 316 mV; I_C = 90 mA; V_{CE} = 18 V; R_L = 75 Ω; T_{amb} = 25 °C;
   measured at $f_{(p+q)}$ = 810 MHz; see Fig.8.



L1 = 8 nH.

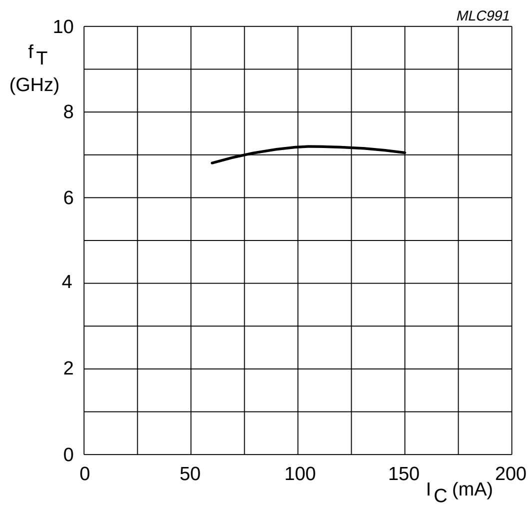
L2 = 15 nH, 2 turns copper wire, internal diameter 2 mm.

L3 = 10 nH, 2 turns copper wire, internal diameter 1.5 mm.

L5: Lp = 21 mm; Rc = 75 Ω.

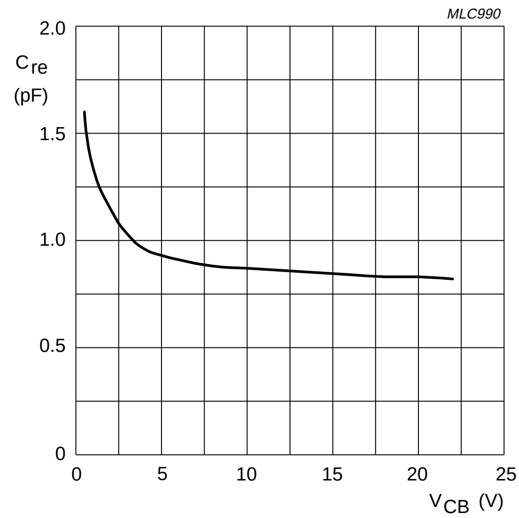
L6: Lp = 16 mm; Rc = 75 Ω.

Fig.2 Intermodulation distortion and second order distortion MATV test circuit.



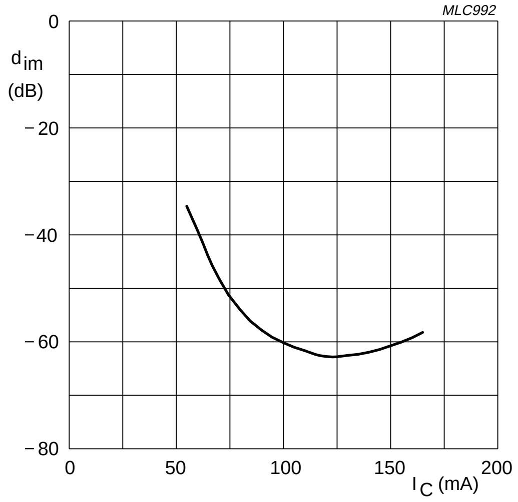
V_{CE} = 18 V; f = 1 GHz.

Fig.3 Transition frequency as a function of collector current; typical values.



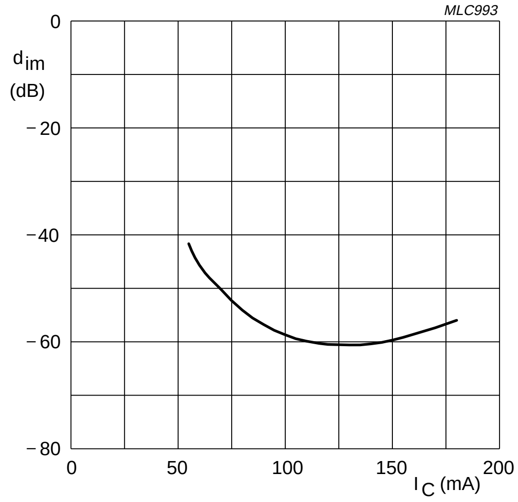
I_C = 0; f = 1 MHz.

Fig.4 Feedback capacitance as a function of collector-base voltage; typical values.



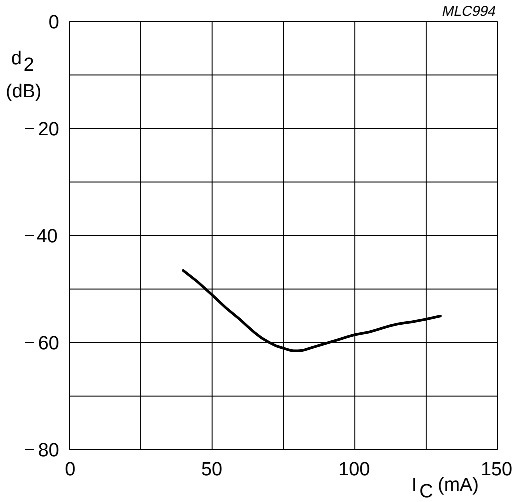
V_O = 1.35 V; V_{CE} = 18 V; $f_{(p+q-r)}$ = 443.25 MHz; see Fig.2.

Fig.5 Intermodulation distortion as a function of collector current; typical values.



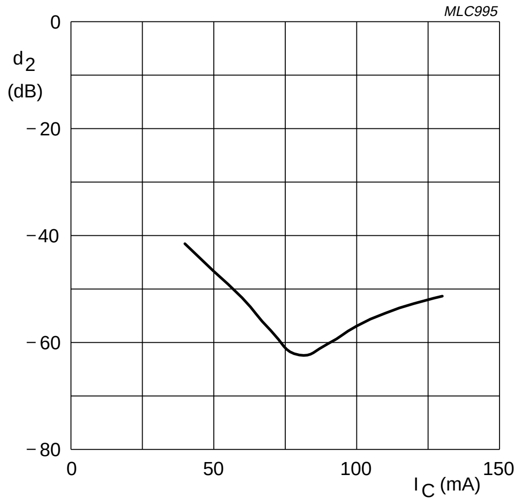
V_O = 1.2 V; V_{CE} = 18 V; $f_{(p+q-r)}$ = 793.25 MHz; see Fig.2.

Fig.6 Intermodulation distortion as a function of collector current; typical values.



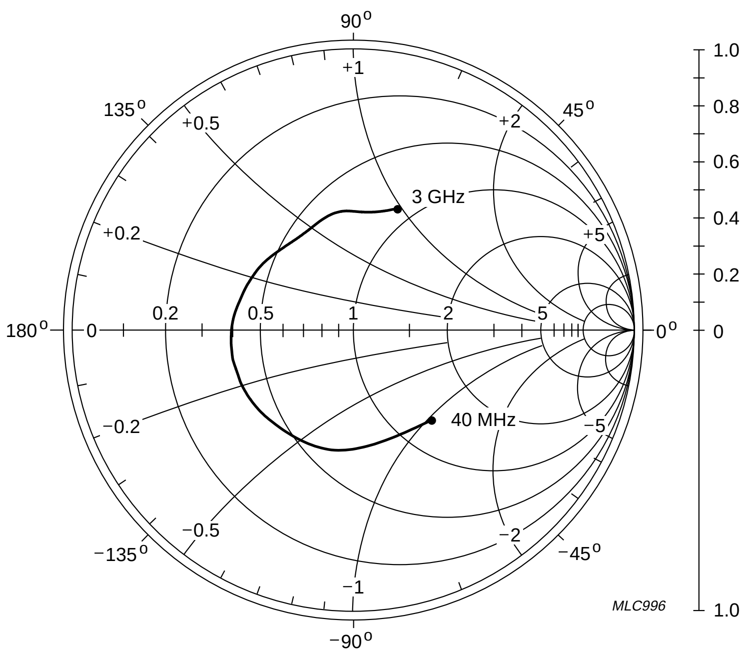
V_O = 50dBmV = 316 mV; V_{CE} = 18 V; $f_{(p+q)}$ = 450 MHz; see Fig.2.

Fig.7 Second order distortion as a function of collector current; typical values.



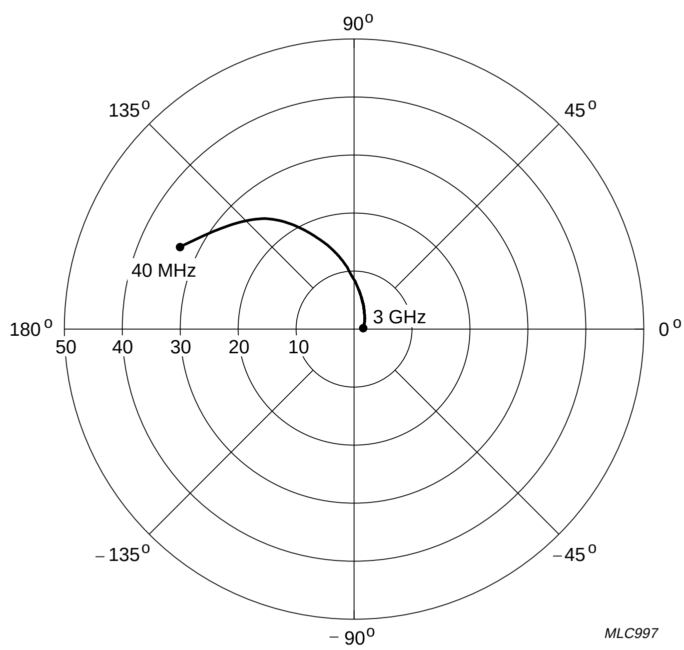
V_O = 50dBmV = 316 mV; V_{CE} = 18 V; $f_{(p+q)}$ = 810 MHz; see Fig.2.

Fig.8 Second order distortion as a function of collector current; typical values.



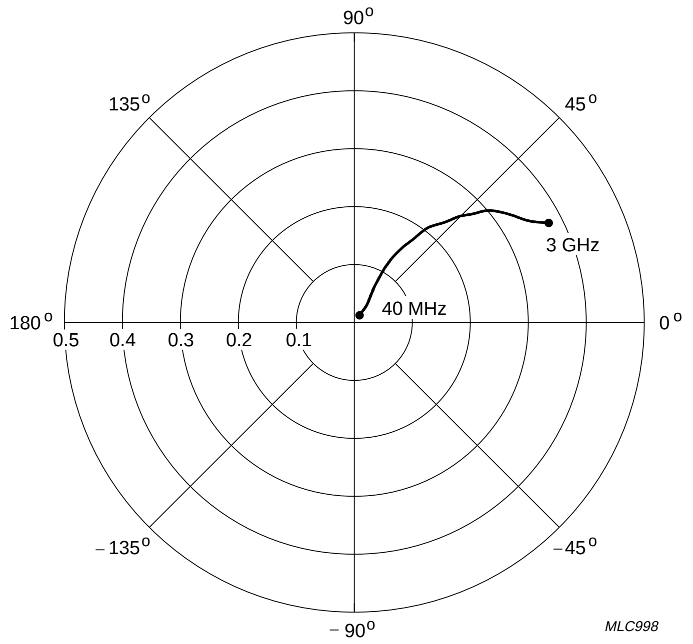
V_{CE} = 18 V; I_C = 120 mA; Z_o = 50 Ω.

Fig.9 Common emitter input reflection coefficient (s_{11}); typical values.



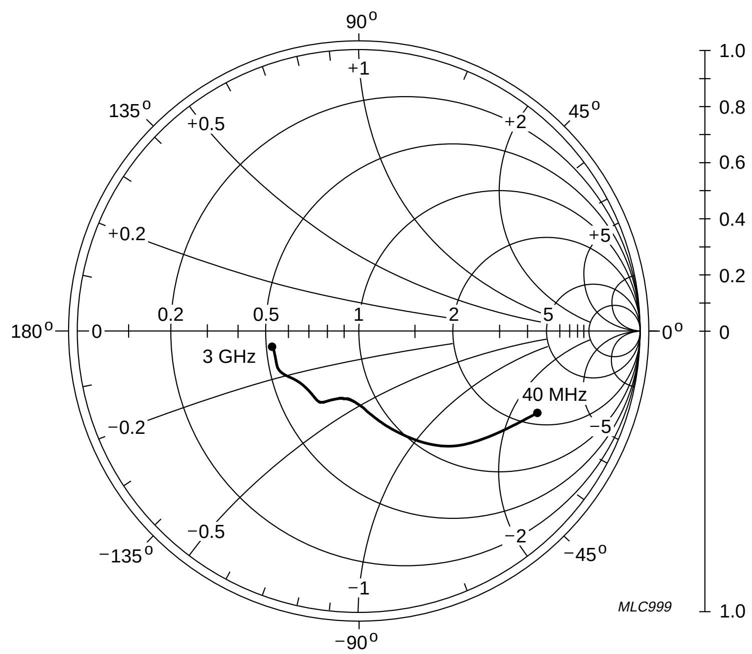
V_{CE} = 18 V; I_C = 120 mA.

Fig.10 Common emitter forward transmission coefficient (s_{21}); typical values.



V_{CE} = 18 V; I_C = 120 mA.

Fig.11 Common emitter reverse transmission coefficient (s_{12}); typical values.



V_{CE} = 18 V; I_C = 120 mA; Z_o = 50 Ω.

Fig.12 Common emitter output reflection coefficient (s_{22}); typical values.

SPICE parameters for the BFQ621 crystal

SEQUENCE No.	PARAMETER	VALUE	UNIT
1	IS	1.358	fA
2	BF	112.2	–
3	NF	0.991	–
4	VAF	78.06	V
5	IKF	4.291	A
6	ISE	643.3	fA
7	NE	1.851	–
8	BR	5.776	–
9	NR	0.999	–
10	VAR	2.350	V
11	IKR	50.26	mA
12	ISC	2.454	fA
13	NC	1.175	–
14	RB	8.000	Ω
15	IRB	1.000	μA
16	RBM	8.000	Ω
17	RE	1.585	Ω
18	RC	1.880	Ω
19(1)	XTB	0.000	–
20(1)	EG	1.110	eV
21(1)	XTI	3.000	–
22	CJE	3.985	pF
23	VJE	0.600	V
24	MJE	0.327	–
25	TF	14.02	ps
26	XTF	398.1	–
27	VTF	2.940	mV
28	ITF	3.084	A
29	PTF	45.00	deg
30	CJC	1.529	pF
31	VJC	0.216	V
32	MJC	0.158	–
33	XCJC	0.120	–
34	TR	9.070	ns
35(1)	CJS	0.000	F
36(1)	VJS	750.0	mV
37(1)	MJS	0.000	–
38	FC	0.735	–

Note

1. These parameters have not been extracted, the default values are shown.

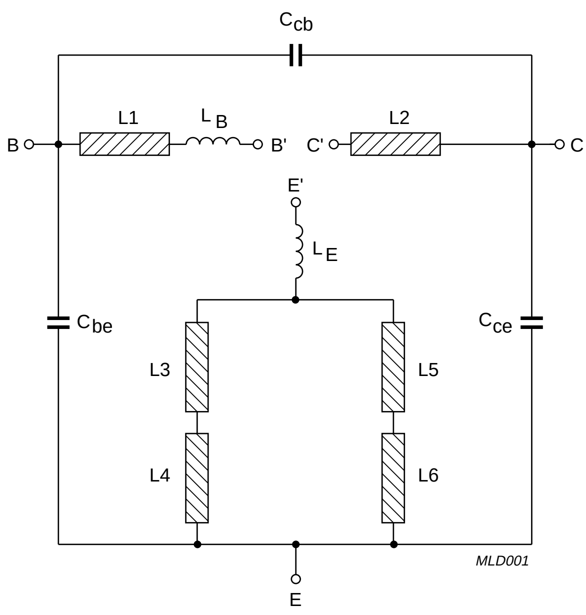


Fig.13 Package equivalent circuit SOT172A2.

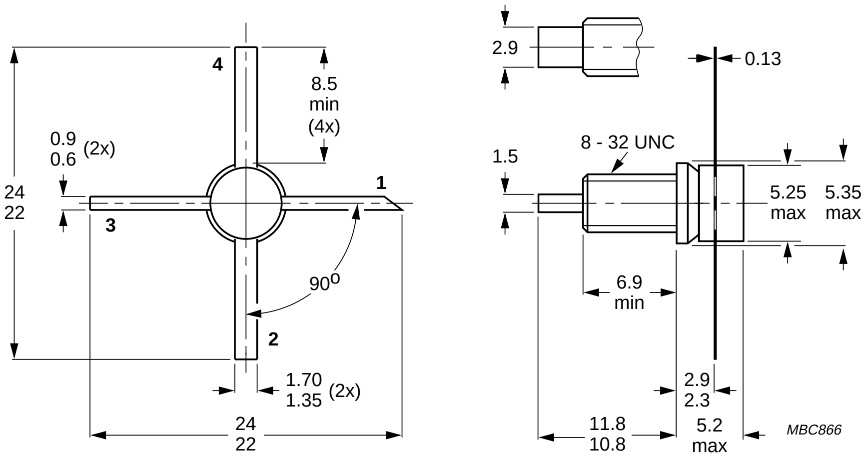
List of components (see Fig.13)

DESIGNATION	VALUE	UNIT
C_{be}	225	fF
C_{cb}	36	fF
C_{ce}	362	fF
L1(1)	L = 1.37; W = 2.64	mm
L2(1)	L = 1.60; W = 2.64	mm
L3(1)	L = 0.51; W = 0.33	mm
L4(1)	L = 0.81; W = 2.06	mm
L5(1)	L = 2.77; W = 0.33	mm
L6(1)	L = 0.94; W = 2.06	mm
L_B	1.85	nH
L_E	1.22	nH

Note

1. The micro striplines are on a double copper-clad substrate; ε_r = 6.5; h = 1.18 mm.

PACKAGE OUTLINE



Dimensions in mm.

Fig.14 SOT172A2.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

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