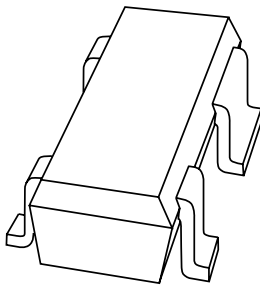


# DATA SHEET



## **BFG480W** NPN wideband transistor

Preliminary specification  
Supersedes data of 1998 Mar 06  
File under Discrete Semiconductors, SC14

1998 Jul 09

**NPN wideband transistor**

**BFG480W**

**FEATURES**

- High power gain
- High efficiency
- Low noise figure
- High transition frequency
- Emitter is thermal lead
- Low feedback capacitance
- Linear and non-linear operation.

**APPLICATIONS**

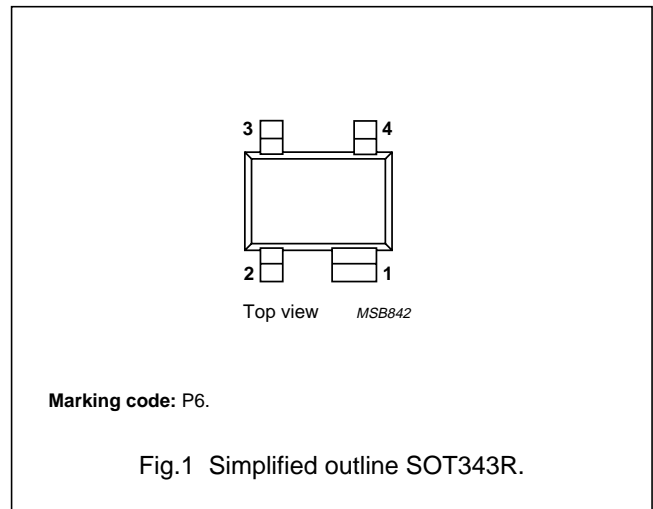
- RF front end with high linearity system demands (CDMA)
- Common emitter class AB driver.

**DESCRIPTION**

NPN double polysilicon wideband transistor with buried layer for low voltage applications in a plastic, 4-pin dual-emitter SOT343R package.

**PINNING**

PIN	DESCRIPTION
1	emitter
2	base
3	emitter
4	collector



**QUICK REFERENCE DATA**

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{CEO}$	collector-emitter voltage	open base	–	–	4.5	V
$I_C$	collector current (DC)		–	80	250	mA
$P_{tot}$	total power dissipation	$T_s \leq 60\text{ }^\circ\text{C}$	–	–	360	mW
$f_T$	transition frequency	$I_C = 80\text{ mA}; V_{CE} = 2\text{ V}; f = 2\text{ GHz}; T_{amb} = 25\text{ }^\circ\text{C}$	–	23	–	GHz
$G_{max}$	maximum gain	$I_C = 80\text{ mA}; V_{CE} = 2\text{ V}; f = 2\text{ GHz}; T_{amb} = 25\text{ }^\circ\text{C}$	–	16	–	dB
F	noise figure	$I_C = 8\text{ mA}; V_{CE} = 2\text{ V}; f = 2\text{ GHz}; \Gamma_S = \Gamma_{opt}$	–	1.8	–	dB
$G_P$	power gain	Pulsed; class-AB; $\delta < 1 : 2$ ; $t_p = 5\text{ ms}$ ; $V_{CE} = 3.6\text{ V}; f = 2\text{ GHz}; P_L = 100\text{ mW}$	12	–	–	dB
$\eta_C$	collector efficiency	Pulsed; class-AB; $\delta < 1 : 2$ ; $t_p = 5\text{ ms}$ ; $V_{CE} = 3.6\text{ V}; f = 2\text{ GHz}; P_L = 100\text{ mW}$	40	–	–	%

**CAUTION**

This product is supplied in anti-static packing to prevent damage caused by electrostatic discharge during transport and handling. For further information, refer to Philips specs.: SNW-EQ-608, SNW-FQ-302A, and SNW-FQ-302B.

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**LIMITING VALUES**

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

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V <sub>CBO</sub>	collector-base voltage	open emitter	–	14.5	V
V <sub>CEO</sub>	collector-emitter voltage	open base	–	4.5	V
V <sub>EBO</sub>	emitter-base voltage	open collector	–	1	V
I <sub>C</sub>	collector current (DC)		–	250	mA
P <sub>tot</sub>	total power dissipation	T <sub>s</sub> ≤ 60 °C; note 1; see Fig.2	–	360	mW
T <sub>stg</sub>	storage temperature		–65	+150	°C
T <sub>j</sub>	operating junction temperature		–	150	°C

**Note**

1. T<sub>s</sub> is the temperature at the soldering point of the emitter pins.

**THERMAL CHARACTERISTICS**

SYMBOL	PARAMETER	VALUE	UNIT
R <sub>th j-s</sub>	thermal resistance from junction to soldering point	250	K/W

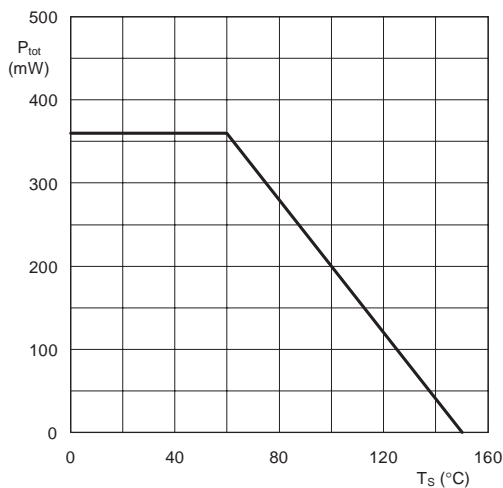


Fig.2 Power derating curve.

## NPN wideband transistor

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## CHARACTERISTICS

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

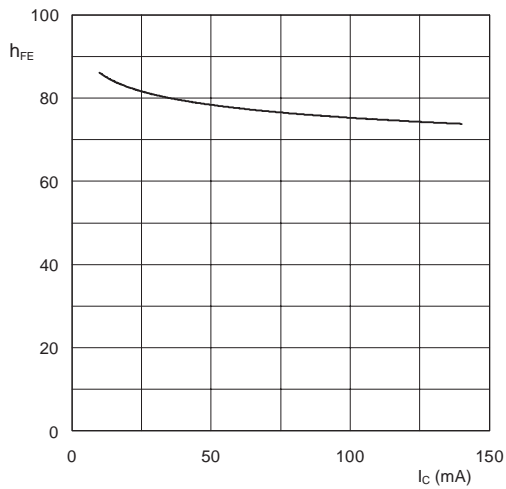
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
$V_{(BR)CBO}$	collector-base breakdown voltage	$I_C = 50\text{ }\mu\text{A}; I_E = 0$	14.5	–	–	V
$V_{(BR)CEO}$	collector-emitter breakdown voltage	$I_C = 5\text{ mA}; I_B = 0$	4.5	–	–	V
$V_{(BR)EBO}$	emitter-base breakdown voltage	$I_E = 100\text{ }\mu\text{A}$	1	–	–	V
$I_{CBO}$	collector-base leakage current	$V_{CE} = 5\text{ V}; V_{BE} = 0$	–	–	70	nA
$h_{FE}$	DC current gain	$I_C = 80\text{ mA}; V_{CE} = 2\text{ V};$ see Fig.3	40	60	100	
$C_c$	collector capacitance	$I_E = i_e = 0; V_{CB} = 2\text{ V}; f = 1\text{ MHz}$	–	1.4	–	pF
$C_e$	emitter capacitance	$I_C = i_c = 0; V_{EB} = 0.5\text{ V}; f = 1\text{ MHz}$	–	2.3	–	pF
$C_{re}$	feedback capacitance	$I_C = 0; V_{CB} = 2\text{ V}; f = 1\text{ MHz};$ see Fig.4	–	350	–	fF
$f_T$	transition frequency	$I_C = 80\text{ mA}; V_{CE} = 2\text{ V}; f = 2\text{ GHz};$ $T_{amb} = 25\text{ }^\circ\text{C};$ see Fig.5	–	23	–	GHz
$G_{max}$	maximum power gain; note 1	$I_C = 80\text{ mA}; V_{CE} = 2\text{ V}; f = 2\text{ GHz};$ $T_{amb} = 25\text{ }^\circ\text{C};$ see Figs 7 and 8	–	16	–	dB
$ S_{21} ^2$	insertion power gain	$I_C = 80\text{ mA}; V_{CE} = 2\text{ V}; f = 2\text{ GHz};$ $T_{amb} = 25\text{ }^\circ\text{C};$ see Fig.8	–	12	–	dB
F	noise figure	$I_C = 8\text{ mA}; V_{CE} = 2\text{ V}; f = 900\text{ MHz};$ $\Gamma_S = \Gamma_{opt};$ see Fig.13	–	1.2	–	dB
		$I_C = 8\text{ mA}; V_{CE} = 2\text{ V}; f = 2\text{ GHz};$ $\Gamma_S = \Gamma_{opt};$ see Fig.13	–	1.8	–	dB
$P_{L1}$	output power at 1 dB gain compression	Class-AB; $\delta < 1 : 2; t_p = 5\text{ ms};$ $V_{CE} = 3.6\text{ V}; I_{CQ} = 1\text{ mA}; f = 2\text{ GHz}$	–	20	–	dBm
ITO	third order intercept point	$I_C = 80\text{ mA}; V_{CE} = 2\text{ V}; f = 2\text{ GHz};$ $Z_S = Z_{S\text{ opt}}; Z_L = Z_{L\text{ opt}};$ note 2	–	28	–	dBm

## Notes

- $G_{max}$  is the maximum power gain, if  $K > 1$ . If  $K < 1$  then  $G_{max} = \text{MSG}$ ; see Figs 6, 7 and 8.
- $Z_S$  is optimized for noise;  $Z_L$  is optimized for gain.

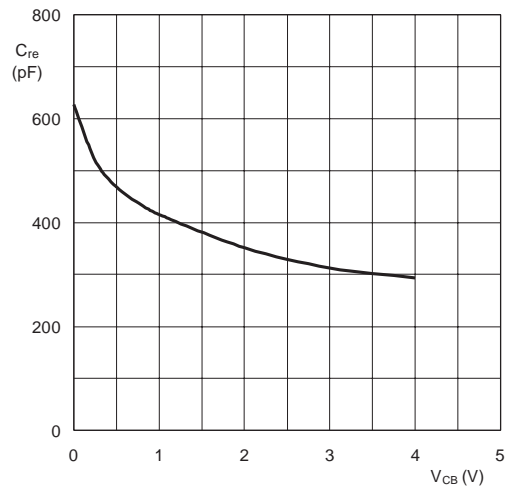
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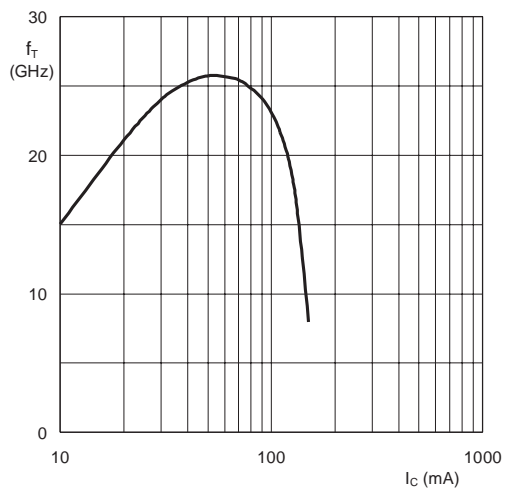
$V_{CE} = 2$  V.

Fig.3 DC current gain as a function of collector current; typical values.



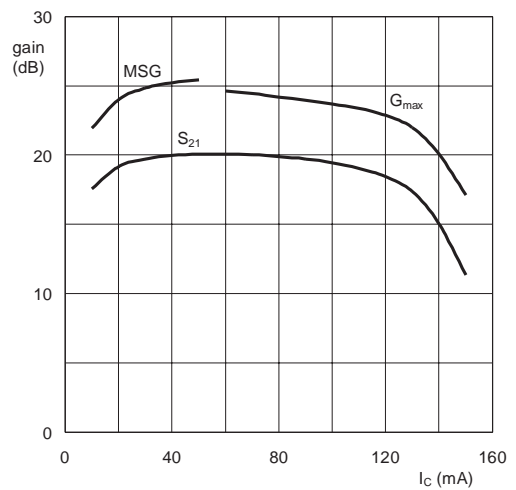
$I_C = 0$ ;  $f = 1$  MHz.

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



$f = 2$  GHz;  $V_{CE} = 2$  V;  $T_{amb} = 25$  °C.

Fig.5 Transition frequency as a function of collector current; typical values.

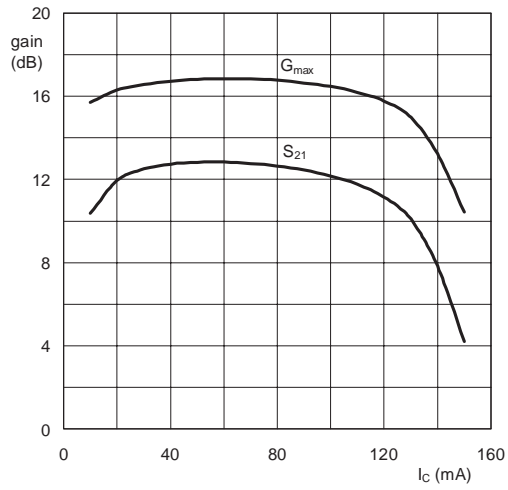


$f = 900$  MHz;  $V_{CE} = 2$  V.

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

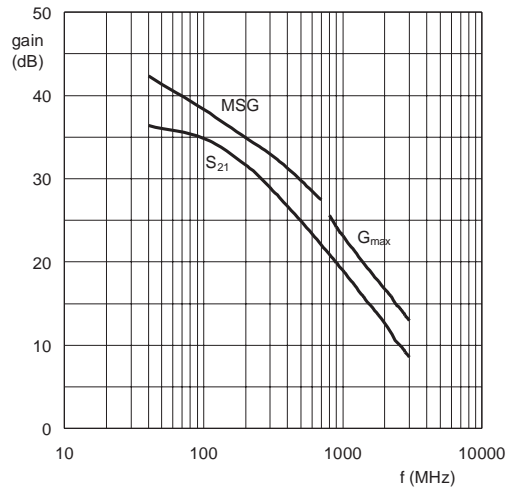
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$V_{CE} = 2\text{ V}; f = 2\text{ GHz}.$

Fig.7 Gain as a function of collector current; typical values.

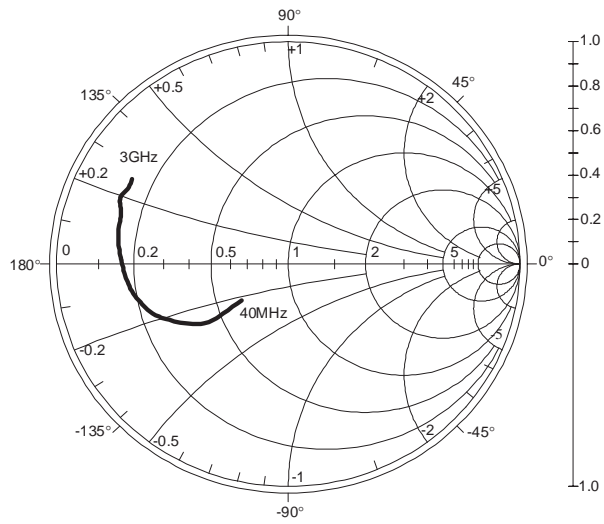


$I_C = 80\text{ mA}; V_{CE} = 2\text{ V}.$

Fig.8 Gain as a function of frequency; typical values.

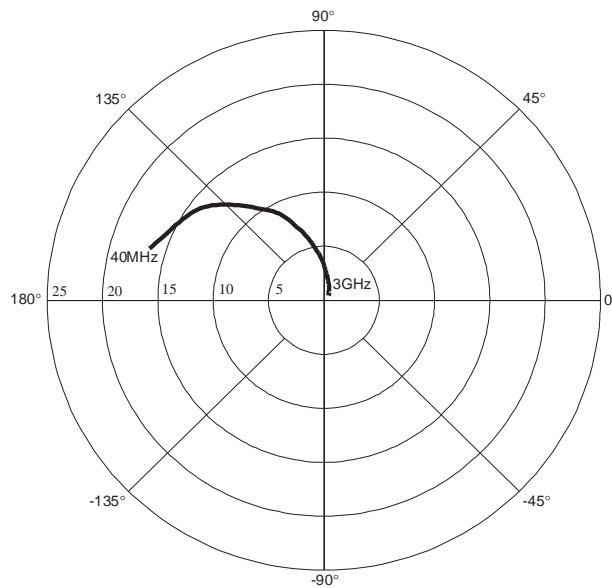
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$I_C = 80 \text{ mA}$ ;  $V_{CE} = 2 \text{ V}$ ;  $Z_0 = 50 \Omega$ .

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

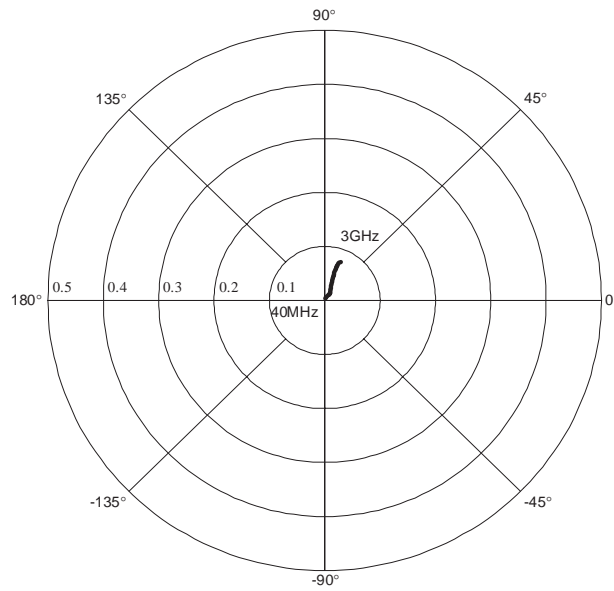


$I_C = 80 \text{ mA}$ ;  $V_{CE} = 2 \text{ V}$ .

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

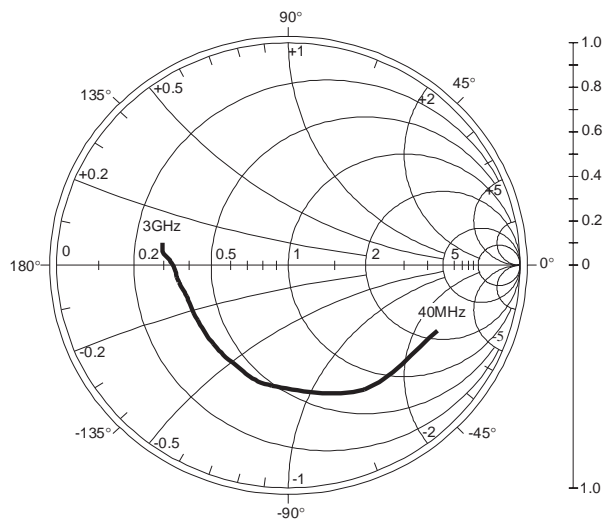
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$I_C = 80 \text{ mA}; V_{CE} = 2 \text{ V}.$

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



$I_C = 80 \text{ mA}; V_{CE} = 2 \text{ V}; Z_0 = 50 \Omega.$

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

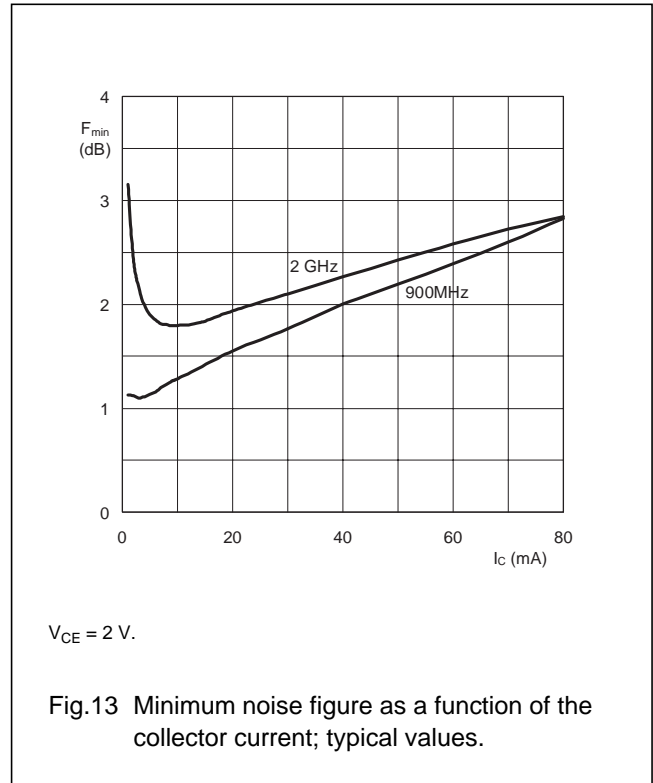
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Noise data

$V_{CE} = 2\text{ V}$ ; typical values.

f (MHz)	I <sub>c</sub> (mA)	F <sub>min</sub> (dB)	Γ <sub>mag</sub>	Γ <sub>angle</sub>	r <sub>n</sub> (Ω)
900	2	1.1	0.41	96.1	0.21
	4	1.1	0.31	106.6	0.14
	6	1.2	0.27	118.4	0.12
	8	1.2	0.26	131.7	0.10
	10	1.3	0.28	143.2	0.10
	20	1.6	0.39	166.2	0.07
	40	2.0	0.49	176.0	0.07
	60	2.3	0.57	179.5	0.07
2000	80	2.9	0.45	177.3	0.18
	2	2.4	0.57	171.9	0.09
	4	2.0	0.49	178.9	0.08
	6	1.8	0.46	-175.7	0.09
	8	1.8	0.44	-171.7	0.09
	10	1.8	0.43	-168.4	0.09
	12	1.8	0.44	-165.3	0.10
	14	1.8	0.44	-163.7	0.10
	20	1.9	0.46	-158.3	0.11
	40	2.3	0.52	-150.2	0.14
	60	2.6	0.56	-147.7	0.18
	80	2.8	0.60	-146.1	0.22



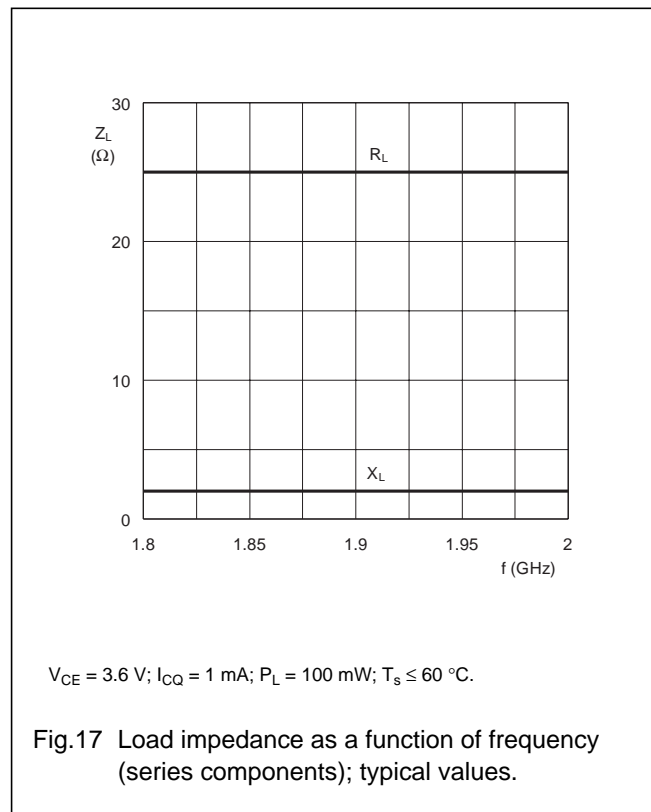
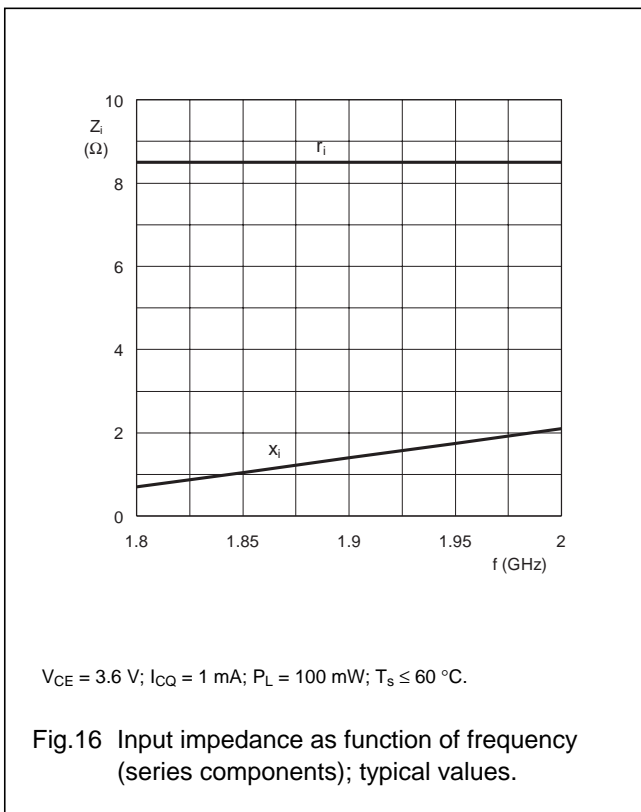
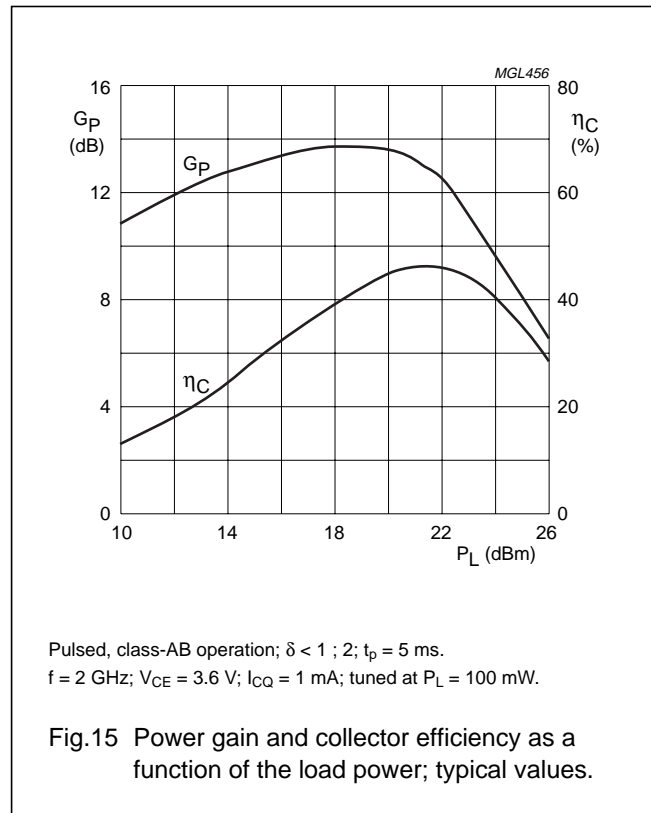
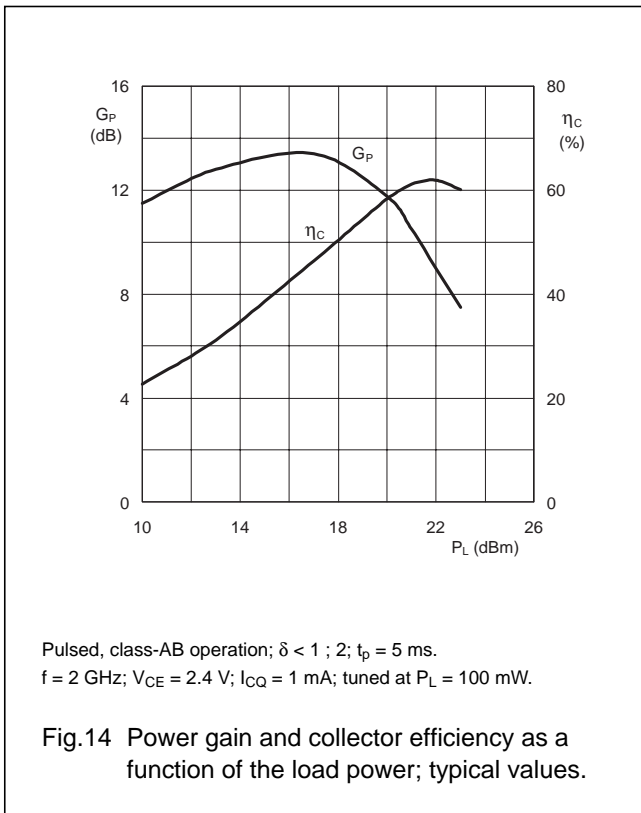
APPLICATION INFORMATION

RF performance at  $T_s \leq 60\text{ °C}$  in a common emitter test circuit (see Figs 18 and 19).

MODE OF OPERATION	f (GHz)	V <sub>CE</sub> (V)	I <sub>CQ</sub> (mA)	P <sub>L</sub> (mW)	G <sub>p</sub> (dB)	η <sub>c</sub> (%)
Pulsed; class-AB; δ < 1 : 2; t <sub>p</sub> = 5 ms	2	3.6	1	100	typ. 13.5	typ. 45

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## NPN wideband transistor

## BFG480W

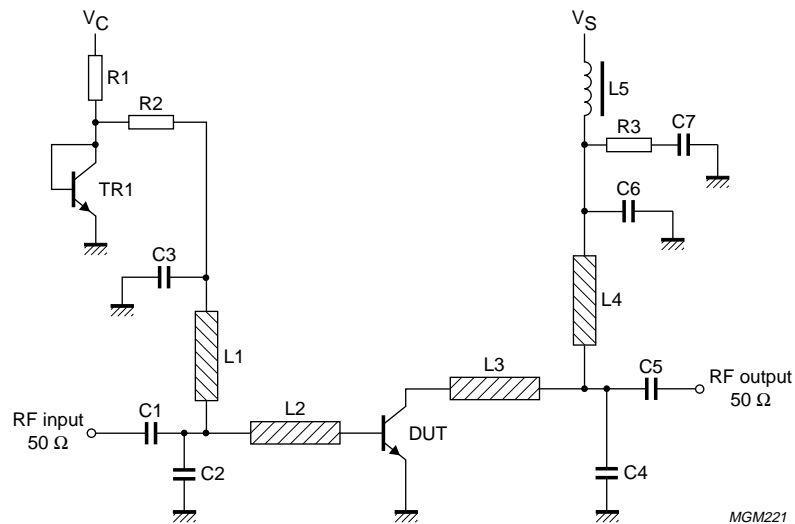


Fig.18 Common emitter test circuit for class-AB operation at 2 GHz.

## List of components used in test circuit (see Figs 18 and 19)

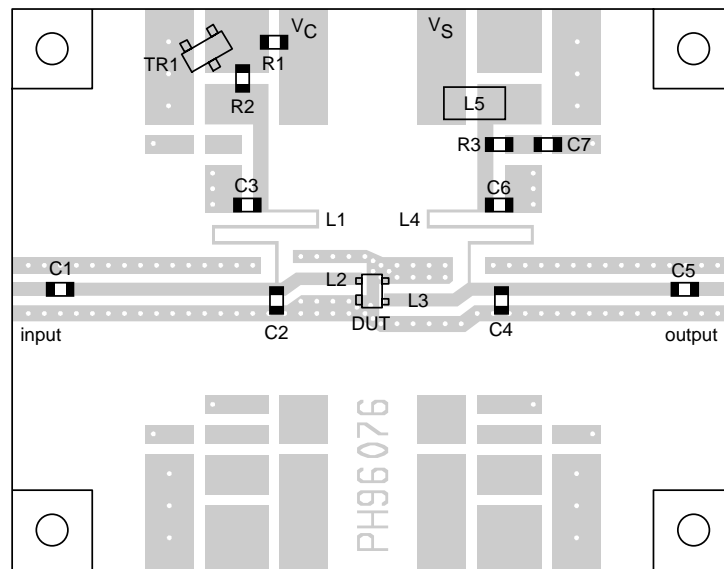
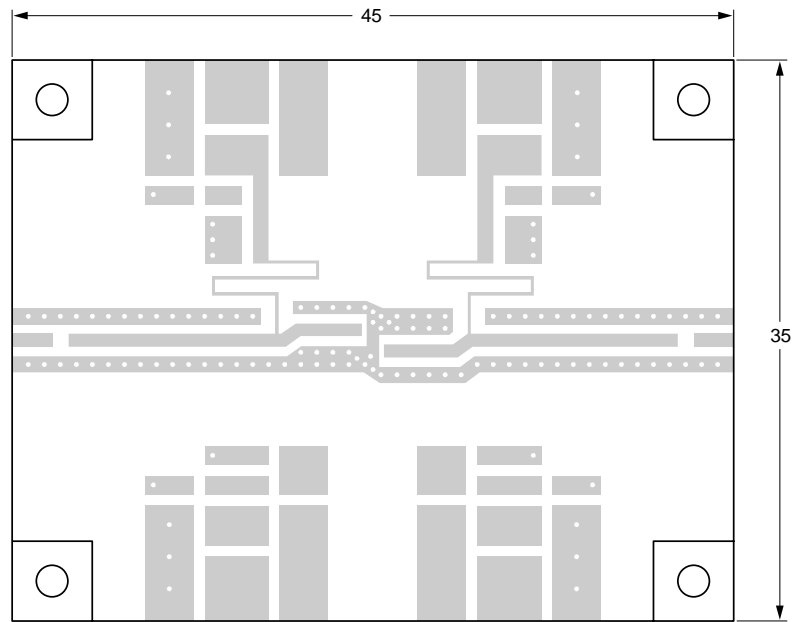
COMPONENT	DESCRIPTION	VALUE	DIMENSIONS	CATALOGUE No.
C1, C5	multilayer ceramic chip capacitor; note 1	24 pF		
C2, C4	multilayer ceramic chip capacitor; note 1	2 pF		
C3, C6	multilayer ceramic chip capacitor; note 1	15 pF		
C7	multilayer ceramic chip capacitor; note 1	1 nF		
L1, L4	stripline; note 2	100 Ω	18 x 0.2 mm	
L2	stripline; note 2	50 Ω	5 x 0.8 mm	
L3	stripline; note 2	50 Ω	6 x 0.8 mm	
L5	Grade 4S2 Ferroxcube chip bead			4330 030 36300
R1	metal film resistor	220 Ω; 0.4 W		
R2, R3	metal film resistor	10 Ω; 0.4 W		
TR1	NPN transistor	BC817		9335 895 20215

## Notes

- American Technical Ceramics type 100A or capacitor of same quality.
- The striplines are on a double copper-clad printed-circuit board with PTFE fibre-glass dielectric ( $\epsilon_r = 6.15$ ,  $\tan \delta = 0.0019$ ); thickness 0.64 mm, copper cladding = 35  $\mu\text{m}$ .

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Dimensions in mm.

The components are situated on one side of the copper-clad PTFE fibre-glass board, the other side is unetched and serves as a ground plane. Earth connections from the component side to the ground plane are made by through metallization.

Fig.19 Printed-circuit board and component lay-out for 2 GHz class-AB test circuit in Fig.18.

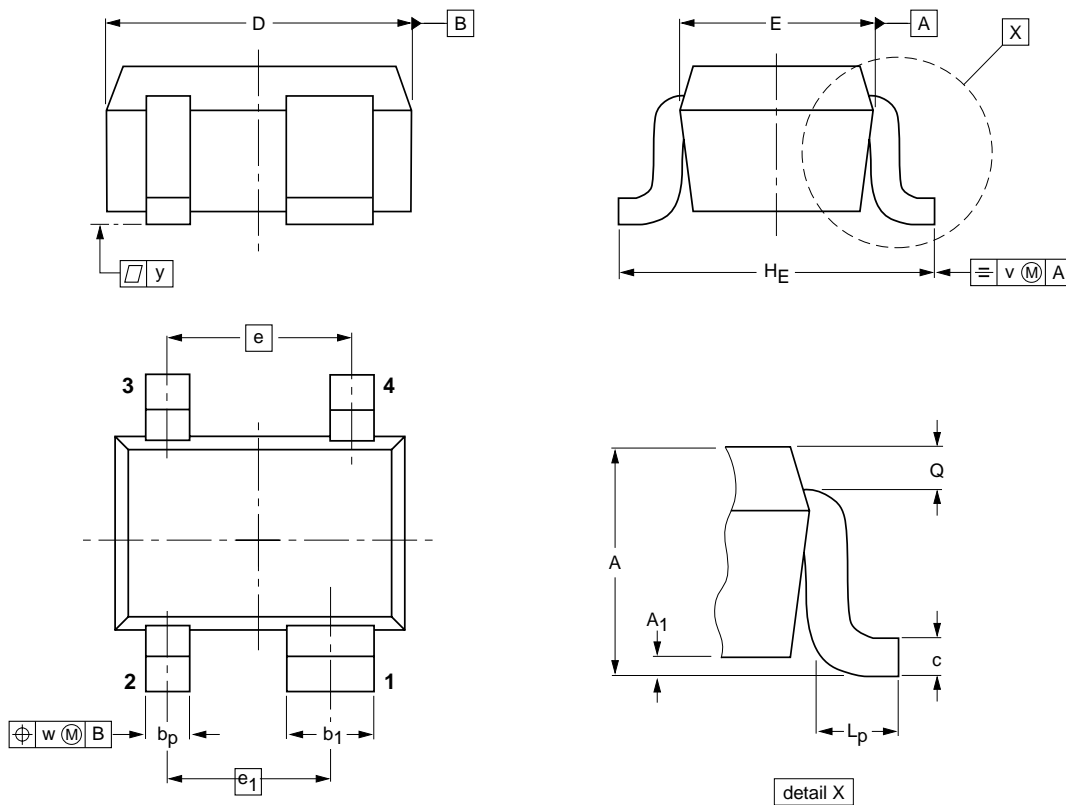
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PACKAGE OUTLINE

Plastic surface mounted package; reverse pinning; 4 leads

SOT343R



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>1</sub> max	b <sub>p</sub>	b <sub>1</sub>	c	D	E	e	e <sub>1</sub>	H <sub>E</sub>	L <sub>p</sub>	Q	v	w	y
mm	1.1 0.8	0.1	0.4 0.3	0.7 0.5	0.25 0.10	2.2 1.8	1.35 1.15	1.3	1.15	2.2 2.0	0.45 0.15	0.23 0.13	0.2	0.2	0.1

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT343R						97-05-21

## NPN wideband transistor

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**DEFINITIONS**

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

**LIFE SUPPORT APPLICATIONS**

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

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**NOTES**

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