

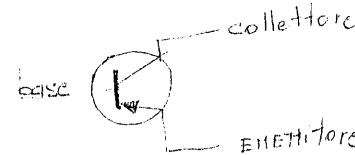
COMPONENTI
ELETTRONICI E MATERIALI
PHILIPS

DATI TECNICI

sezione ELCOMA - Rep. Microelettronica

P-N-P = tensione negativa di collettore

NPN = tensione positiva di collettore



S1 a

S1 a

TRANSISTORI AL GERMANIO E
AL SILICIO PER RADIO E TV

TRANSISTORI AL GERMANIO E
AL SILICIO PER RADIO E TV

PHILIPS S.p.A. - Sez. ELCOMA - Piazza IV Novembre, 3 - MILANO - Tel. 69.94

PHILIPS S.p.A. - Sez. ELCOMA - Piazza IV Novembre, 3 - MILANO - Tel. 69.94

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.

3. 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.

4. 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.

NOTE

It is common use to apply the Absolute Maximum System in semiconductor published data.

LETTER SYMBOLS

LETTER SYMBOLS FOR SEMICONDUCTOR DEVICES excluding power diodes and thyristors

This system is based on the Recommendations of the INTERNATIONAL ELECTROTECHNICAL COMMISSION as published in I.E.C. Publication 148.

QUANTITY SYMBOLS

- Instantaneous values of current, voltage and power, which vary with time are represented by the appropriate lower case letter.

Examples: i , v , p

- Maximum (peak), average, d.c. and root-mean-square values are represented by the appropriate upper case letter.

Examples: I , V , P

SUBSCRIPTS FOR QUANTITY SYMBOLS

- Total values are indicated by upper case subscripts.

Examples: I_C , I_{CM} , I_{CAV} , i_C , V_{EB}

- Values of varying components are indicated by lower case subscripts.

Examples: i_c , I_c , v_{eb} , V_{eb}

- To distinguish between maximum (peak), average, d.c. and root-mean-square values, the following subscripts are added:

For maximum (peak) values : M or m

For average values : AV or av (only if it is necessary to distinguish between d.c. and average)

For d.c. values : no additional subscript

For root-mean-square values : (rms)

Examples: I_C , I_{cm} , I_{CAV} , $I_{c(rms)}$, $I_{C(rms)}$

4. List of subscripts (examples, see figure 1)

A, a	= Anode terminal
K, k	= Cathode terminal
E, e	= Emitter terminal
B, b	= Base terminal
C, c	= Collector terminal
(BR)	= Break-down
X, x	= Specified circuit
M, m	= Maximum (peak) value
AV, av	= Average value
(rms)	= R.M.S. value
F, f	= Forward
R, r	= As first subscript : Reverse. As second subscript : Repetitive
O	= As third subscript : The terminal not mentioned is open circuited
S	= As second subscript : Non repetitive As third subscript : Short circuit between the terminal not mentioned and the reference terminal
Z	= Zener. (Replaces R to indicate the actual zener voltage, current or power of voltage reference or voltage regulator diodes)

5. Examples of the application of the rules:

Figure 1 represents a transistor collector current, consisting of a direct current and a signal, as a function of time.

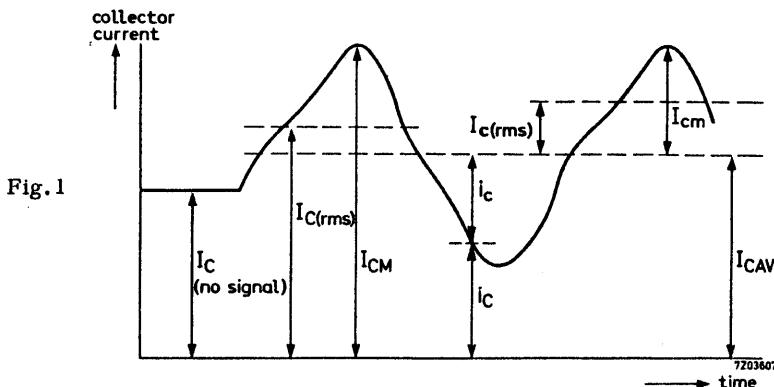


Fig. 1

CONVENTIONS FOR SUBSCRIPT SEQUENCE1. Currents

For transistors the first subscript indicates the terminal carrying the current (conventional current flow from the external circuit into the terminal is positive)

For diodes a forward current (conventional current flow into the anode terminal) is represented by the subscript F or f; a reverse current (conventional current flow out of the anode terminal) is represented by the subscript R or r.

2. Voltages

For transistors normally, two subscripts are used to indicate the points between which the voltage is measured. The first subscript indicates one terminal point and the second the reference terminal.

Where there is no possibility of confusion, the second subscript may be omitted.

For diodes a forward voltage (anode positive with respect to cathode) is represented by the subscript F or f and a reverse voltage (anode negative with respect to cathode) by the subscript R or r.

3. Supply voltages

Supply voltages may be indicated by repeating the terminal subscript.

Examples: V_{EE} , V_{CC} , V_{BB}

The reference terminal may then be indicated by a third subscript.

Examples: V_{EEB} , V_{CCB} , V_{BBC}

4. In devices having more than one terminal of the same type, the terminal subscripts are modified by adding a number following the subscript and on the same line.

Example: V_{B2-E} voltage between second base and emitter

In multiple unit devices, the terminal subscripts are modified by a number preceding the terminal subscripts:

Example: V_{1B-2B} voltage between the base of the first unit and that of the second one.

ELECTRICAL PARAMETER SYMBOLS

1. The values of four pole matrix parameters or other resistances, impedances admittances, etc... inherent in the device, are represented by the lower case symbol with the appropriate subscripts.

Examples: h_{ib} , z_{fb} , y_{oc} , h_{FE}

2. The four pole matrix parameters of external circuits and of circuits in which the device forms only a part are represented by the upper case symbols with the appropriate subscripts.

Examples: H_i , Z_o , H_F , Y_R

SUBSCRIPTS FOR PARAMETER SYMBOLS

1. The static values of parameters are indicated by upper case subscripts.

Examples: h_{IB} , h_{FE}

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.

2. The small-signal values of parameters are indicated by lower case subscripts.

Examples: h_{ib} , z_{ob}

3. The first subscript, in matrix notation identifies the element of the four pole matrix.

- i (for 11) = input
- o (for 22) = output
- f (for 21) = forward transfer
- r (for 12) = reverse transfer

Examples: $V_1 = h_i I_1 + h_r V_2$
 $I_2 = h_f I_1 + h_o V_2$

Notes 1) The voltage and current symbols in matrix notation are indicated by a single digit subscript.

The subscript 1 = input; the subscript 2 = output

2) The voltages and currents in these equations may be complex quantities.

4. The second subscript identifies the circuit configuration.

e = common emitter

b = common base

c = common collector

j = common terminal, general

Examples: (common base)

$$I_1 = y_{ib} V_{1b} + y_{rb} V_{2b}$$

$$I_2 = y_{fb} V_{1b} + y_{ob} V_{2b}$$

When the common terminal is understood, the second subscript may be omitted.

5. If it is necessary to distinguish between real and imaginary parts of the four pole parameters, the following notations may be used.

$\text{Re}(h_{ib})$ etc.. for the real part

$\text{Im}(h_{ib})$ etc.. for the imaginary part

Letter symbol	Definition
C_c	¹⁾ Collector capacitance (emitter open-circuited to a.c. and d.c.)
C_d	¹⁾ Diode capacitance
C_e	¹⁾ Emitter capacitance (collector open-circuited to a.c. and d.c.)
$C_{ib}, C_{ie}, C_{ob}, C_{oe}$	¹⁾ See y parameters
d	Distortion
F	Noise figure
f	Frequency
$f_{hfb}, f_{hfe}, f_{yfe}$	Cut-off frequency (frequency at which the parameter indicated by the subscript is 0.7 of its low frequency value)
f_T	Transition frequency (Gain-bandwidth product)
$g_{ie}, g_{ib}, g_{oe}, g_{ob}$	See y parameters
G_p	Power gain
G_S	Source conductance
G_{tr}	Transducer gain
G_{UM}	Maximum unilateralised power gain
h_{FB}, h_{FC}, h_{FE}	Static value of the forward current transfer ratio or D.C. current gain (output voltage held constant)
h_{fb}, h_{fc}, h_{fe}	Small-signal value of the forward current transfer ratio or Small-signal current gain (output short-circuited to a.c.)
h_{IB}, h_{IC}, h_{IE}	Static value of the input resistance (output voltage held constant)
h_{ib}, h_{ic}, h_{ie}	Small-signal value of the input impedance (output short-circuited to a.c.)

¹⁾ As an exception to the general rule for electrical parameters capacitances are represented by the upper-case letter.

Letter symbol	Definition
h_{OB} , h_{OC} , h_{OE}	Static value of the output conductance (input current held constant)
h_{ob} , h_{oc} , h_{oe}	Small-signal value of the output admittance (input open-circuited to a.c.)
h_{RB} , h_{RC} , h_{RE}	Static value of the reverse voltage transfer ratio (input current held constant)
h_{rb} , h_{rc} , h_{re}	Small-signal value of the reverse voltage transfer ratio (input open-circuited to a.c.)
I_B , I_C , I_E	Total d.c. (or average) current
i_b , i_c , i_e	Varying component of the current
$i_{B\bar{A}}$, $i_{C\bar{A}}$, $i_{E\bar{A}}$	Instantaneous total value of the current
$i_{B\bar{E}}$, $i_{C\bar{E}}$	Instantaneous value of the varying component of the current
I_{BAV} , I_{CAV} , $I_{EA\bar{V}}$	Total average current (to distinguish between average and d.c. if necessary)
I_{BEX} , I_{CEX}	Total base, respectively collector current under specified conditions. These symbols are commonly used in case of a reverse biased emitter junction
I_{BM} , I_{CM} , I_{EM}	Maximum (peak) value of the total current
i_{bm} , i_{cm} , i_{em}	Maximum (peak) value of the varying component of the current
I_{CBO}	Collector cut-off current (open emitter)
I_{CEO}	Collector cut-off current (open base)
I_{CBS} or I_{CES}	Collector cut-off current (emitter short-circuited to base)
I_{EBO}	Emitter cut-off current (open collector)
I_F	Total forward current of a diode (d.c. or average)
i_F	Instantaneous total value of the forward current of a diode
I_{FAV}	Total average forward current of a diode (to distinguish between average and d.c. if necessary)
I_{FM}	Peak forward current of a diode

7Z3 0345

Letter symbol	Definition
I_j , I_o	Input, respectively output current of a specified circuit
I_R	Total reverse (cut-off) current of a diode
i_R	Instantaneous total value of the reverse current of a diode
I_{RRM}	Repetitive peak reverse current of a diode
I_{RSM}	Non repetitive peak reverse current of a diode
I_Z	Zener current (d.c. or average)
i_{ZM}	Peak zener current
I_{ZS}	Non repetitive zener current
P_i , P_o	Input, respectively output power of a specified circuit
P_{tot}	Total power dissipation in the device
P_Z	Zener power dissipation
P_{ZM}	Peak zener power dissipation
P_{ZSM}	Non repetitive peak zener power dissipation
Q_s	Recovered charge
r_D	Diode (internal) series resistance
R_S	Source resistance
R_{th}	Thermal resistance
$R_{th j-a}$	Thermal resistance from junction to ambient
$R_{th j-mb}$	Thermal resistance from junction to mounting base
$R_{th j-c}$	Thermal resistance from junction to case
$R_{th mb-h}$	Thermal resistance from mounting base to heatsink
r_z	Dynamic-slope resistance of a zener diode
S_z	Temperature coefficient of the operating voltage of a zener diode
T_{amb}	Ambient temperature
T_{case}	Case temperature

7Z3 0346

Letter symbol	Definition
t_d	Delay time
t_f	Fall time
t_{fr}	Forward recovery time of a diode
T_j	Junction temperature
t_{off}	Turn off time ($t_{off} = t_s + t_f$)
t_{on}	Turn on time ($t_{on} = t_d + t_r$)
t_r	Rise time
t_{rr}	Reverse recovery time of a diode
t_s	Storage time
T_{stg}	Storage temperature
V_{BB}, V_{CC}, V_{EE}	Supply voltage
$V_{BE}, V_{CB}, V_{CE}, V_{EB}$	Total value of the voltage (d.c. or average)
$V_{be}, V_{cb}, V_{ce}, V_{eb}$	Varying component of the voltage
$v_{BE}, v_{CB}, v_{CE}, v_{EB}$	Instantaneous value of the total voltage
$v_{be}, v_{cb}, v_{ce}, v_{eb}$	Instantaneous value of the varying component of the voltage
V_{BEfl}	Base-emitter floating voltage (open base)
V_{BESat}, V_{CESat}	Saturation voltage at specified bottoming conditions
$V_{(BR)}$	Breakdown voltage
$V_{(BR)CBO}, V_{(BR)CEO}, V_{(BR)EBO}$	Breakdown voltage between the terminal indicated by the first subscript and the reference terminal (second subscript) when the third terminal is open circuited
$V_{(BR)CER}$	Collector-emitter breakdown voltage with a specified resistance between emitter and base
$V_{(BR)CES}$	Collector-emitter breakdown voltage with the emitter short circuited to the base
$V_{CBO}, V_{CEO}, V_{EBO}$	Voltage of the terminal indicated by the first subscript w.r.t. the reference terminal (second subscript) with the third terminal open circuited
V_{CEK}	Knee voltage at specified conditions

7Z3 0347

Letter symbol	Definition
V_{CER}	Collector-emitter voltage with a specified resistance between emitter and base
V_{CES}	Collector-emitter voltage with the emitter short circuited to the base
$V_{CE.sust}$	Collector-emitter sustaining voltage under the condition, indicated by the third subscript
V_{CEX}	Collector-emitter voltage in a specified circuit. This symbol is commonly used to indicate a reverse biased emitter junction
V_{EBfl}	Emitter-base floating voltage (open emitter)
V_F	Continuous forward voltage of a diode
V_{FM}	Peak forward voltage of a diode
V_i, V_o	Input, respectively output voltage of a specified circuit
V_{pt}	Punch through voltage
V_R	Continuous reverse voltage of a diode
V_{RM}	Peak reverse voltage of a diode
V_{RSM}	Non repetitive peak reverse voltage of a diode
V_Z	Operating voltage (zener voltage) of a zener diode
y_{ib}, y_{ie}	Input admittance
g_{ib}, g_{ie}	Input conductance
C_{ib}, C_{ie}	Input capacitance
$\varphi_{ib}, \varphi_{ie}$	Phase angle of input admittance
y_{fb}, y_{fe}	Transfer admittance
g_{fb}, g_{fe}	Transfer conductance
C_{fb}, C_{fe}	Transfer capacitance
$\varphi_{fb}, \varphi_{fe}$	Phase angle of transfer admittance

7Z3 0348

Letter symbol	Definition
y_{ob}, y_{oe}	Output admittance
g_{ob}, g_{oe}	Output conductance
C_{ob}, C_{oe}	Output capacitance
$\varphi_{ob}, \varphi_{oe}$	Phase angle of output admittance
y_{rb}, y_{re}	Feedback admittance
g_{rb}, g_{re}	Feedback conductance
C_{rb}, C_{re}	Feedback capacitance
$\varphi_{rb}, \varphi_{re}$	Phase angle of feedback admittance

7Z3 0349

TRANSISTORI AL GERMANIO
PER BASSA FREQUENZA E
IMPIEGHI GENERALI

GERMANIUM ALLOY TRANSISTOR

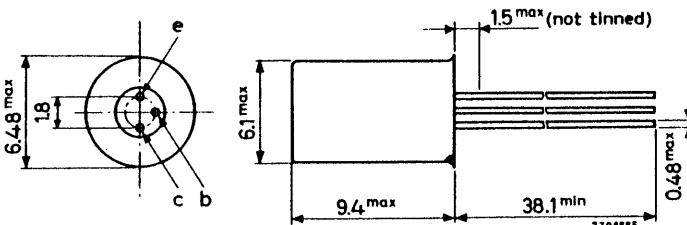
P-N-P transistor in a TO-1 metal envelope intended for use in pre-amplifier or driver stages.

QUICK REFERENCE DATA		
Collector-base voltage (open emitter)	$-V_{CBO}$	max. 32 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max. 12 V
Collector current (d.c.)	$-I_C$	max. 100 mA
Total power dissipation up to $T_{amb} = 45^\circ\text{C}$ with cooling fin No. 56227 on a heatsink of at least 12.5 cm^2	P_{tot}	max. 500 mW
Junction temperature	T_j	max. 90 $^\circ\text{C}$
D.C. current gain at $T_{amb} = 25^\circ\text{C}$ $-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$	h_{FE}	> 50 typ. 100
Small signal current gain at $T_{amb} = 25^\circ\text{C}$ $I_E = 2 \text{ mA}; -V_{CB} = 5 \text{ V}; f = 1 \text{ kHz}$	h_{fe}	typ. 125 80 to 170
Transition frequency $-I_C = 10 \text{ mA}; -V_{CE} = 2 \text{ V}$	f_T	typ. 1.7 MHz

MECHANICAL DATA

Dimensions in mm

TO-1



The coloured dot indicates the collector

Accessories available: 56200, 56208, 56209, 56210, 56226, 56227

RATINGS (Limiting values)¹⁾Voltages

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	32	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	12	V
Collector-emitter voltage with $R_{BE} < 1 \text{ k}\Omega$	$-V_{CER}$	max.	32	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	10	V

Currents

Collector current (d.c.)	$-I_C$	max.	100	mA
Emitter current (peak value)	I_{EM}	max.	200	mA

Power dissipation

Total power dissipation up to $T_{\text{amb}} = 45^\circ\text{C}$
with cooling fin No. 56227 mounted on a
heatsink of at least 12.5 cm^2

P_{tot} max. 500 mW

Temperatures

Storage temperature	T_{stg}	-55 to +90	$^\circ\text{C}$
Junction temperature	T_j	max.	90 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to ambient in free air

$R_{\text{th j-a}} = 0.3 \text{ }^\circ\text{C/mW}$

From junction to ambient with cooling
fin No. 56227 mounted on a heatsink
of at least 12.5 cm^2

$R_{\text{th j-a}} = 0.09 \text{ }^\circ\text{C/mW}$

CHARACTERISTICS

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

Collector cut-off current

$I_B = 0; -V_{CB} = 10 \text{ V}$	$-I_{CBO}$	<	10	μA
$I_B = 0; -V_{CB} = 32 \text{ V}; T_j = 75^\circ\text{C}$	$-I_{CBO}$	<	800	μA

Emitter cut-off current

$I_C = 0; -V_{EB} = 5 \text{ V}; T_j = 75^\circ\text{C}$	$-I_{EBO}$	<	550	μA
--	------------	---	-----	---------------

Emitter-base voltage

$I_E = 2 \text{ mA}; -V_{CB} = 5 \text{ V}$	V_{EB}	typ.	105	mV
$I_E = 100 \text{ mA}; V_{CB} = 0$	V_{EB}	<	400	mV

D.C. current gain

$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$	h_{FE}	>	50
$-I_C = 50 \text{ mA}; V_{CB} = 0$	h_{FE}	typ.	100
$-I_C = 100 \text{ mA}; V_{CB} = 0$	h_{FE}	typ.	95

Collector capacitance at $f = 0.45 \text{ MHz}$

$I_E = I_c = 0; -V_{CB} = 5 \text{ V}$	C_c	typ.	40	pF
$I_E = I_c = 0; -V_{CB} = 0$	C_c	<	50	pF

Feedback impedance at $f = 0.45 \text{ MHz}$

$-I_C = 1 \text{ mA}; -V_{CE} = 5 \text{ V}$	$ z_{rb} $	typ.	90	Ω
--	------------	------	----	----------

Transition frequency

$-I_C = 10 \text{ mA}; -V_{CE} = 2 \text{ V}$	f_T	>	1.3	MHz
$-I_C = 10 \text{ mA}; -V_{CE} = 0$	f_T	typ.	1.7	MHz

Cut-off frequency

$-I_C = 10 \text{ mA}; -V_{CE} = 2 \text{ V}$	f_{hfe}	>	10	kHz
$-I_C = 10 \text{ mA}; -V_{CE} = 0$	f_{hfe}	typ.	17	kHz

Noise figure at $f = 1 \text{ kHz}$

$-I_C = 0.5 \text{ mA}; -V_{CE} = 5 \text{ V}; R_S = 500 \Omega$ Bandwidth = 200 Hz	F	typ.	4	dB
$-I_C = 0.5 \text{ mA}; -V_{CE} = 0$	F	<	10	dB

¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS (continued) $T_{amb} = 25^{\circ}\text{C}$ unless otherwise specified h parameters at $f = 1\text{ kHz}$

$$-I_C = 2\text{ mA}; -V_{CE} = 5\text{ V}$$

Input impedance

$$h_{ie} \quad \text{typ. } 1.7\text{ k}\Omega
1.1 \text{ to } 2.5\text{ k}\Omega$$

Reverse voltage transfer

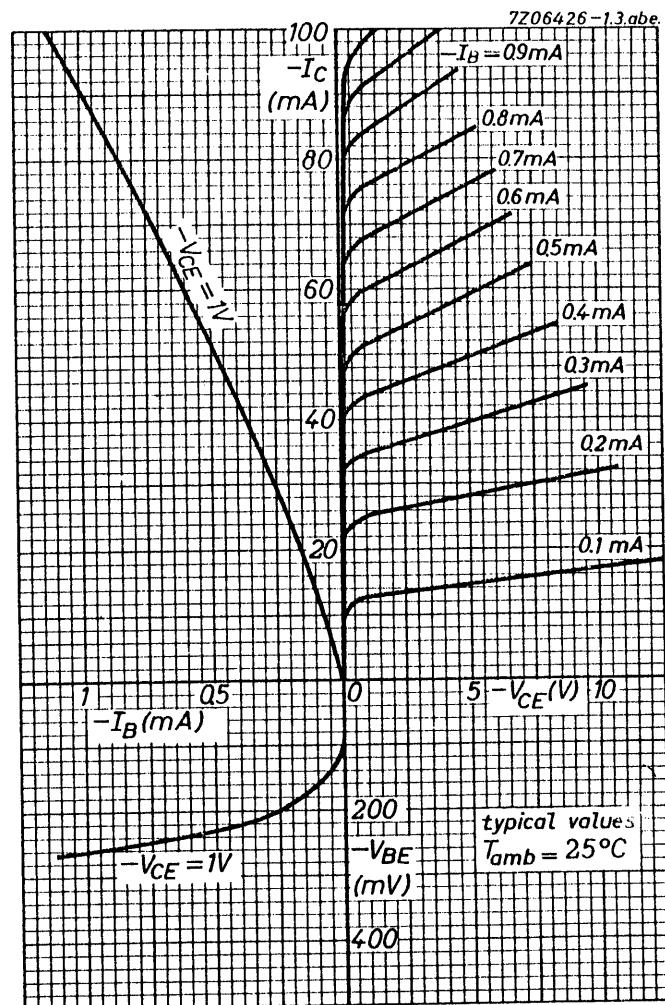
$$h_{re} \quad \text{typ. } 6.5 \cdot 10^{-4}
< 8.5 \cdot 10^{-4}$$

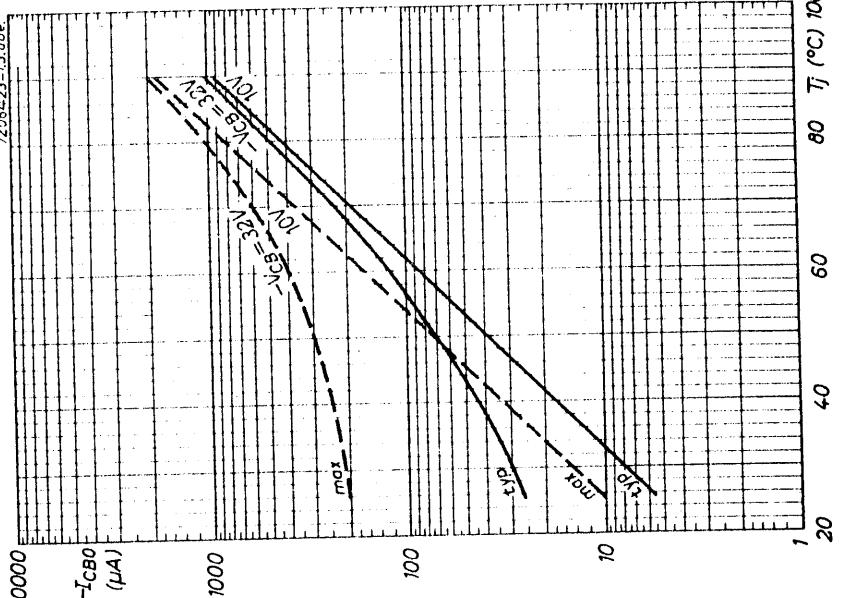
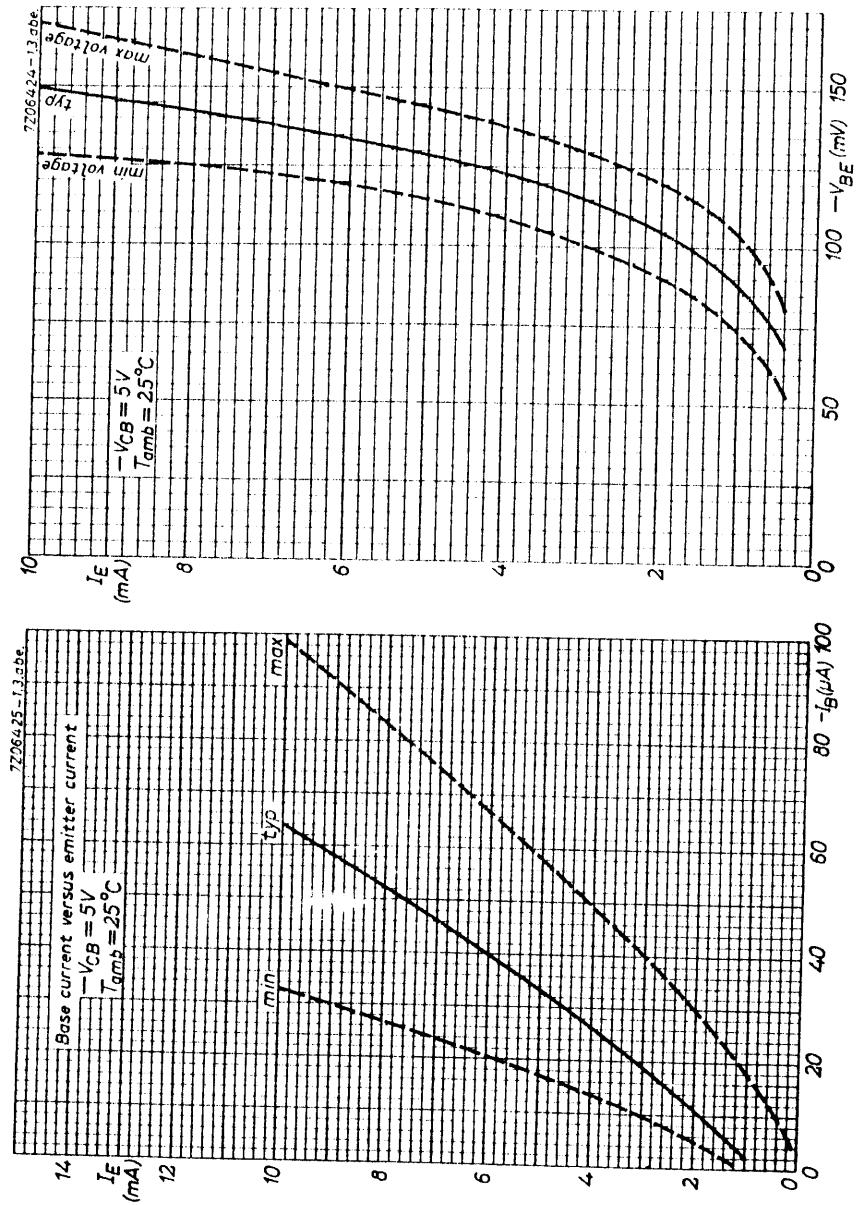
Small signal current gain

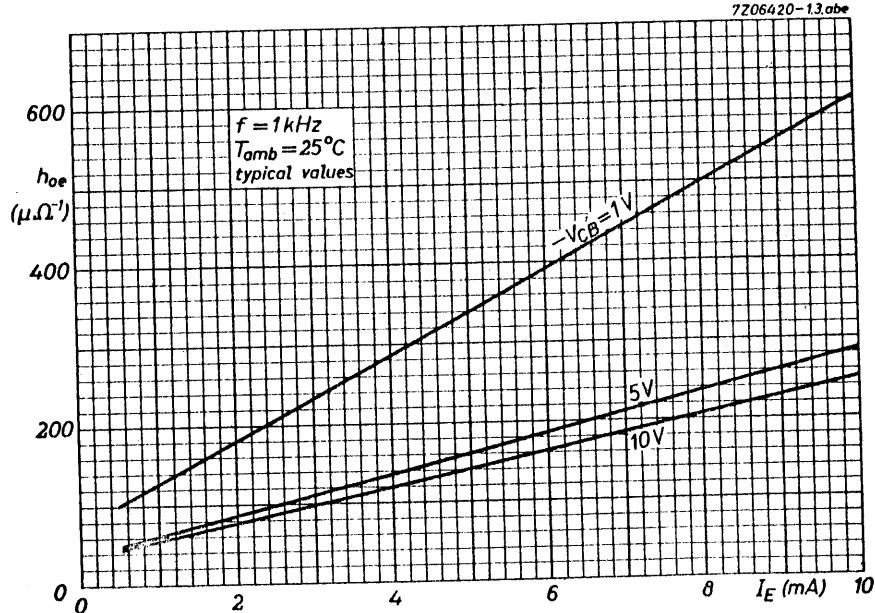
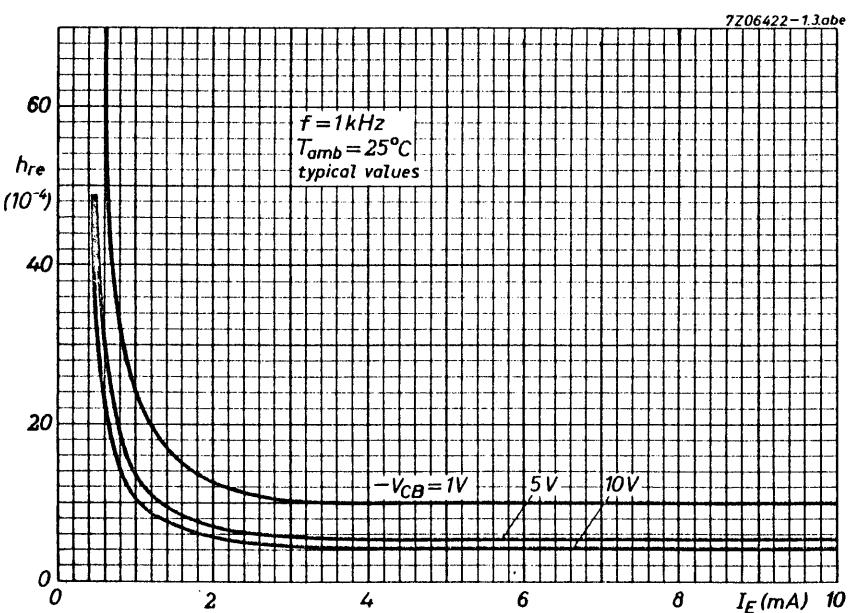
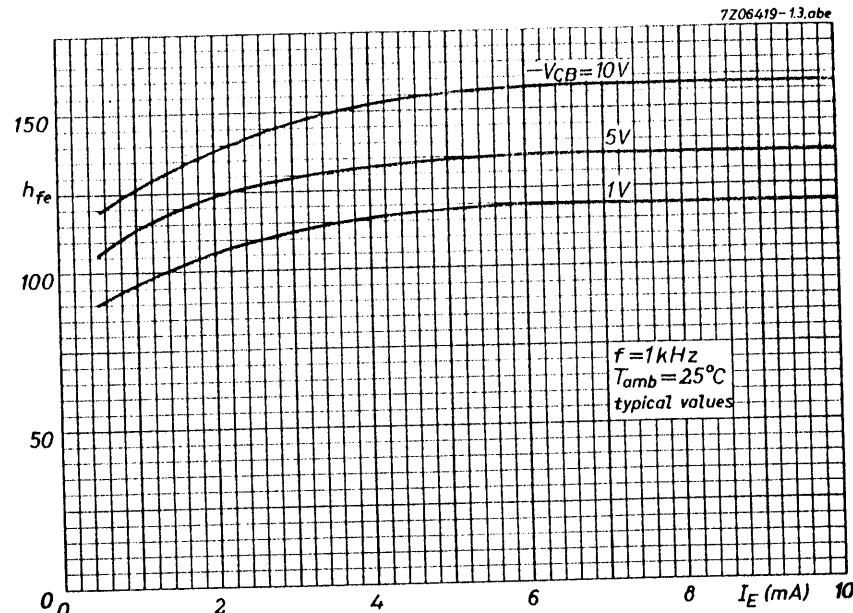
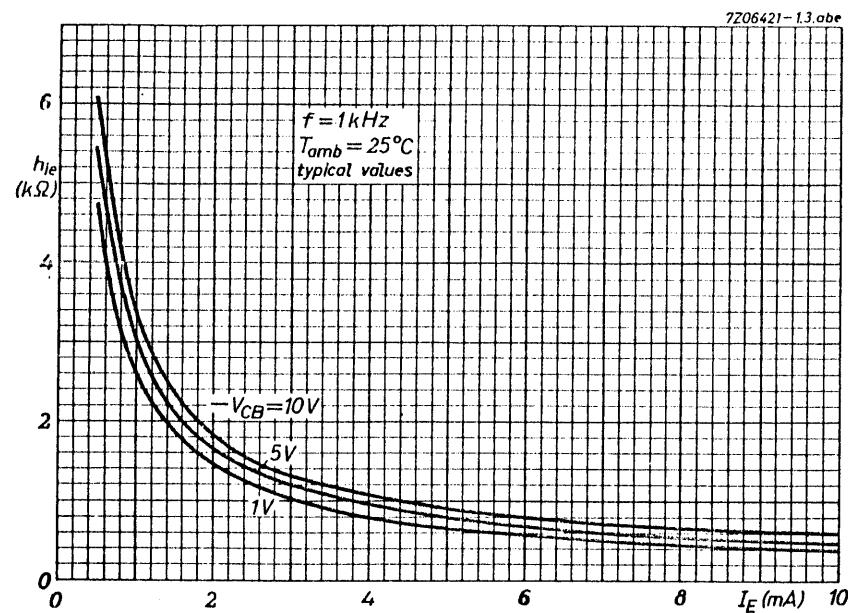
$$h_{fe} \quad \text{typ. } 125
80 \text{ to } 170$$

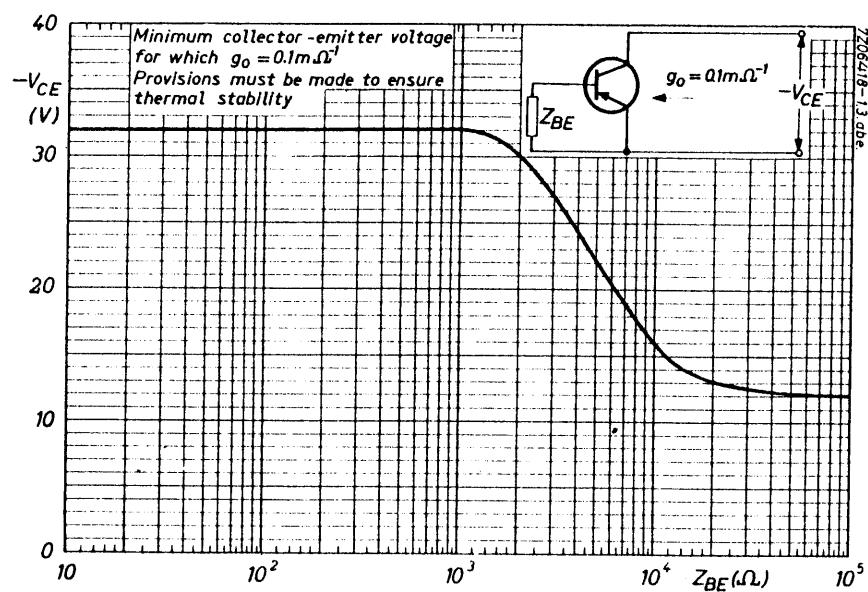
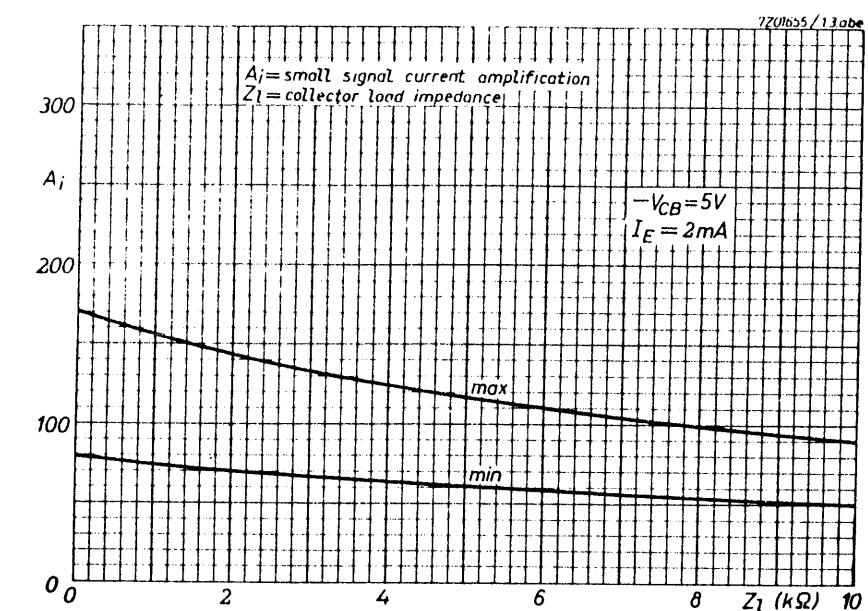
Output admittance

$$h_{oe} \quad \text{typ. } 80\text{ }\mu\Omega^{-1}
< 110\text{ }\mu\Omega^{-1}$$









GERMANIUM ALLOY TRANSISTOR

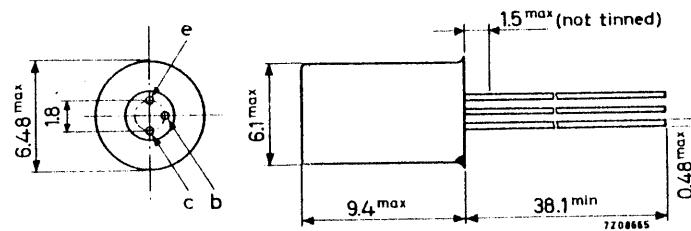
P-N-P transistor in a TO-1 metal envelope intended for use in pre-amplifier or driver stages.

QUICK REFERENCE DATA		
Collector-base voltage (open emitter)	$-V_{CBO}$	max. 32 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max. 12 V
Collector current (d.c.)	$-I_C$	max. 100 mA
Total power dissipation up to $T_{amb} = 45^\circ C$ with cooling fin No. 56227 on a heatsink of at least 12.5 cm ²	P_{tot}	max. 500 mW
Junction temperature	T_j	max. 90 $^\circ C$
D.C. current gain at $T_{amb} = 25^\circ C$ $-I_C = 2 \text{ mA}; -V_{CE} = 5V$	h_{FE}	> 65 typ. 140
Small signal current gain at $T_{amb} = 25^\circ C$ $I_E = 2 \text{ mA}; -V_{CB} = 5 \text{ V}; f = 1 \text{ kHz}$	h_{fe}	typ. 180 130 to 300
Transition frequency $-I_C = 10 \text{ mA}; -V_{CE} = 2 \text{ V}$	f_T	typ. 2.3 MHz

MECHANICAL DATA

Dimensions in mm

TO-1



The coloured dot indicates the collector

Accessories available: 56200, 56208, 56209, 56210, 56226, 56227

RATINGS (Limiting values)¹⁾**Voltages**

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	32	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	12	V
Collector-emitter voltage with $R_{BE} < 1 \text{ k}\Omega$	$-V_{CER}$	max.	32	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	10	V

Currents

Collector current (d.c.)	I_C	max.	100	mA
→ Emitter current (peak value)	I_{EM}	max.	200	mA

Power dissipation

Total power dissipation up to $T_{amb} = 45^\circ\text{C}$ with cooling fin No. 56227 mounted on a heatsink of at least 12.5 cm^2	P_{tot}	max.	500	mW
---	-----------	------	-----	----

Temperatures

Storage temperature	T_{stg}	-55 to +90	$^\circ\text{C}$
Junction temperature	T_j	max.	90 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th j-a} =$	0.3	$^\circ\text{C}/\text{mW}$
From junction to ambient with cooling fin No. 56227 mounted on a heatsink of at least 12.5 cm^2	$R_{th j-a} =$	0.09	$^\circ\text{C}/\text{mW}$

CHARACTERISTICS $T_{amb} = 25^\circ\text{C}$ unless otherwise specified**Collector cut-off current**

$$I_E = 0; -V_{CB} = 10 \text{ V} \quad -I_{CBO} < 10 \mu\text{A}$$

$$I_E = 0; -V_{CB} = 32 \text{ V}; T_j = 75^\circ\text{C} \quad -I_{CBO} < 800 \mu\text{A}$$

Emitter cut-off current

$$I_C = 0; -V_{EB} = 5 \text{ V}; T_j = 75^\circ\text{C} \quad -I_{EBO} < 550 \mu\text{A}$$

Emitter-base voltage

$$I_E = 2 \text{ mA}; -V_{CB} = 5 \text{ V} \quad V_{EB} \text{ typ. } 105 \text{ mV}$$

$$I_E = 100 \text{ mA}; V_{CB} = 0 \quad V_{EB} < 400 \text{ mV}$$

D.C. current gain

$$-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V} \quad h_{FE} \text{ typ. } 140$$

$$-I_C = 50 \text{ mA}; V_{CB} = 0 \quad h_{FE} \text{ typ. } 135$$

$$-I_C = 100 \text{ mA}; V_{CB} = 0 \quad h_{FE} \text{ typ. } 105$$

Collector capacitance at $f = 0.45 \text{ MHz}$

$$I_E = I_e = 0; -V_{CB} = 5 \text{ V} \quad C_c \text{ typ. } 40 \text{ pF}$$

Feedback impedance at $f = 0.45 \text{ MHz}$

$$-I_C = 1 \text{ mA}; -V_{CE} = 5 \text{ V} \quad |z_{rb}| \text{ typ. } 90 \Omega$$

Transition frequency

$$-I_C = 10 \text{ mA}; -V_{CE} = 2 \text{ V} \quad f_T \text{ typ. } 1.7 \text{ MHz}$$

$$-I_C = 10 \text{ mA}; -V_{CE} = 2 \text{ V} \quad f_T \text{ typ. } 2.3 \text{ MHz}$$

$$-I_C = 10 \text{ mA}; -V_{CE} = 2 \text{ V} \quad f_{hfe} \text{ typ. } 10 \text{ kHz}$$

$$-I_C = 10 \text{ mA}; -V_{CE} = 2 \text{ V} \quad f_{hfe} \text{ typ. } 17 \text{ kHz}$$

$$-I_C = 0.5 \text{ mA}; -V_{CE} = 5 \text{ V}; R_S = 500 \Omega \quad F \text{ typ. } 4 \text{ dB}$$

$$\text{Bandwidth} = 200 \text{ Hz} \quad F < 10 \text{ dB}$$

¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS (continued) $T_{amb} = 25^{\circ}\text{C}$ unless otherwise specified h parameters at $f = 1\text{ kHz}$

$$-I_C = 2\text{ mA}; -V_{CE} = 5\text{ V}$$

Input impedance

$$h_{ie} \quad \text{typ. } 2.4 \text{ k}\Omega
1.7 \text{ to } 3.8 \text{ k}\Omega$$

Reverse voltage transfer

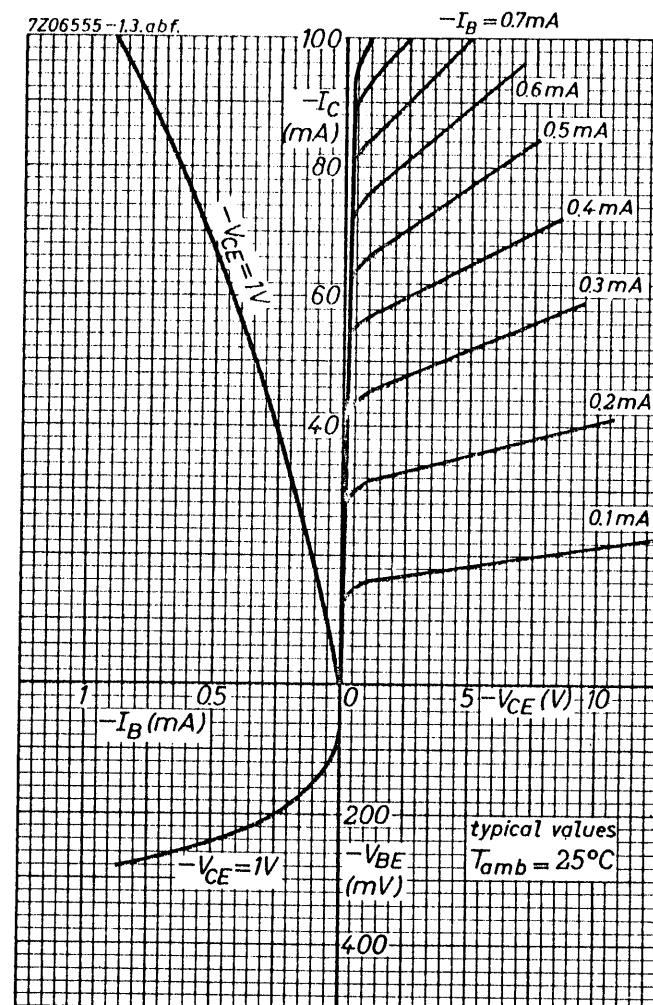
$$h_{re} \quad \text{typ. } 8.0 \text{ } 10^{-4}
< 13.0 \text{ } 10^{-4}$$

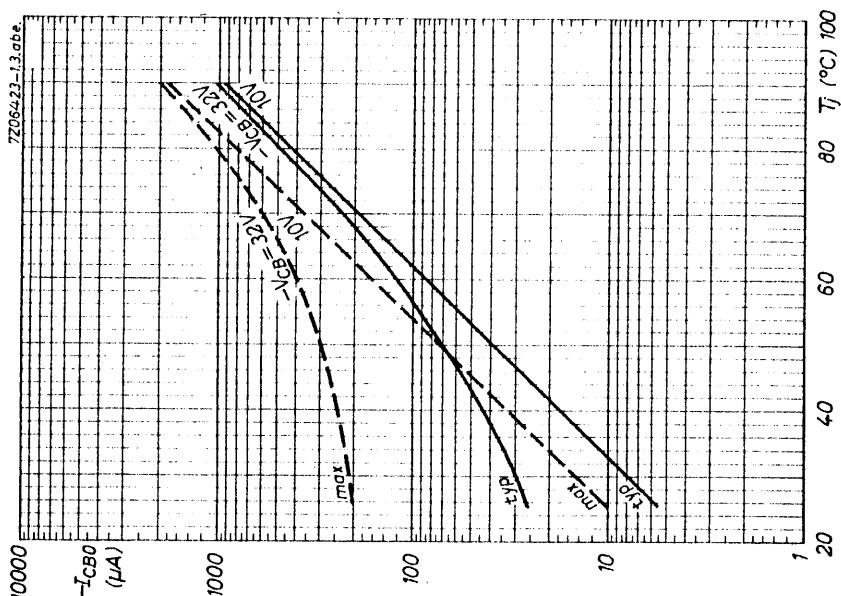
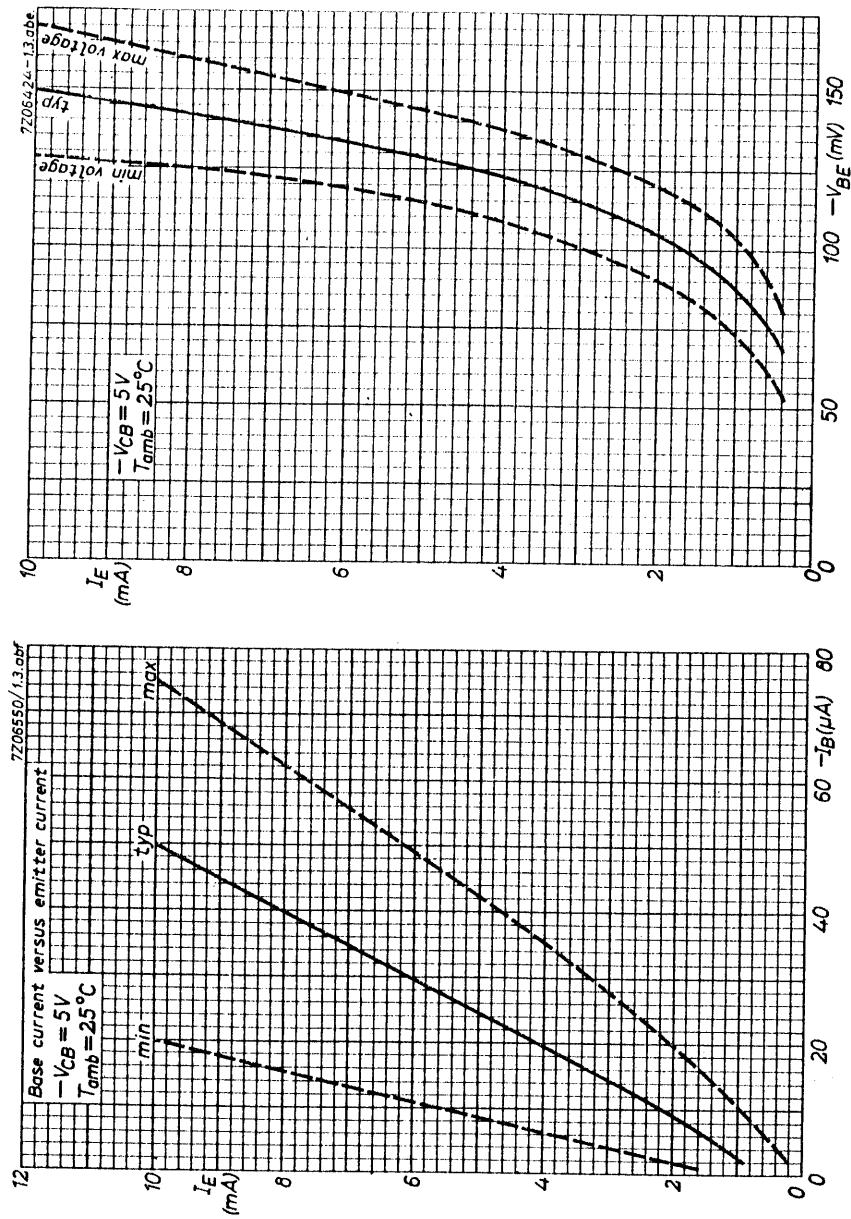
Small signal current gain

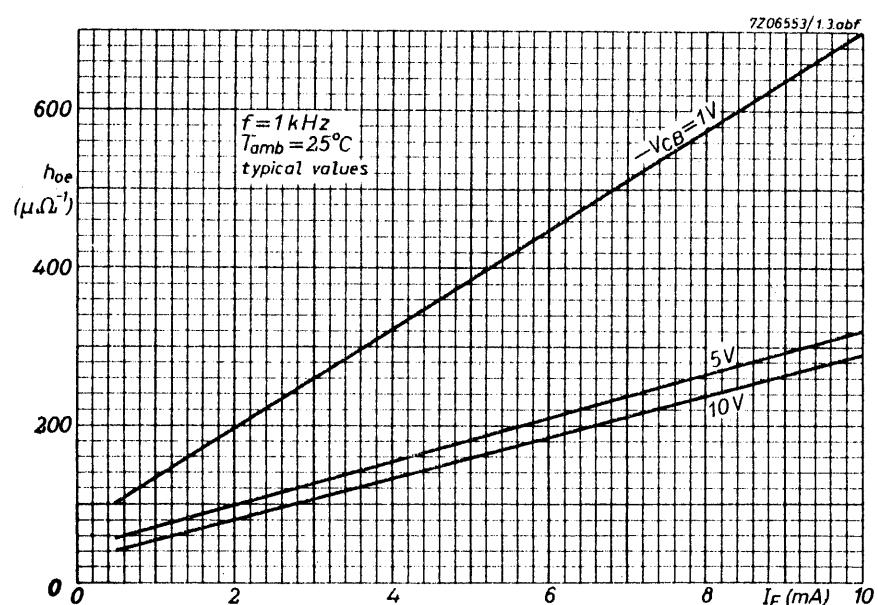
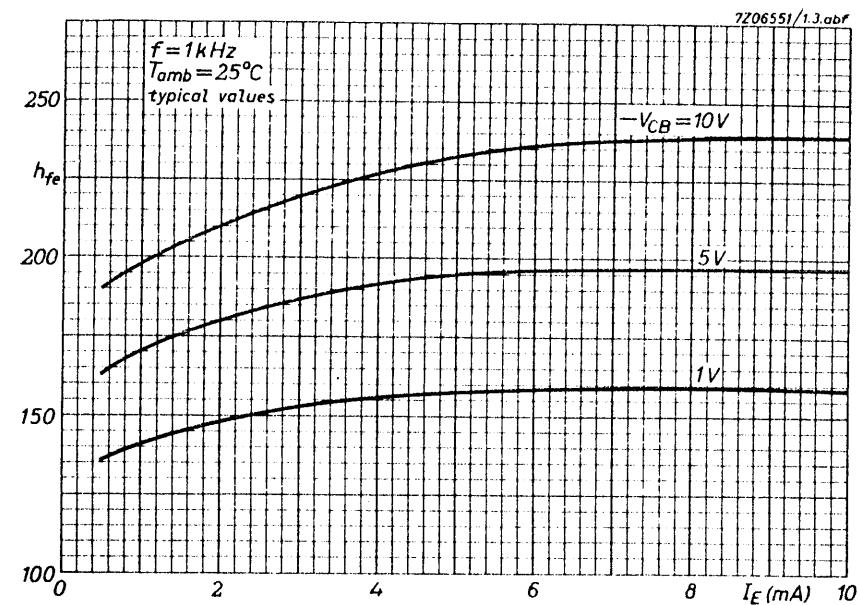
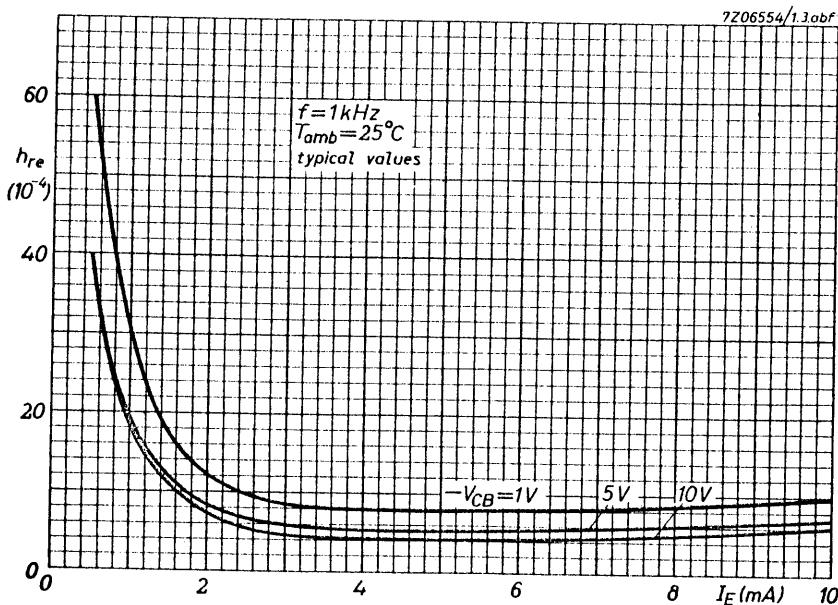
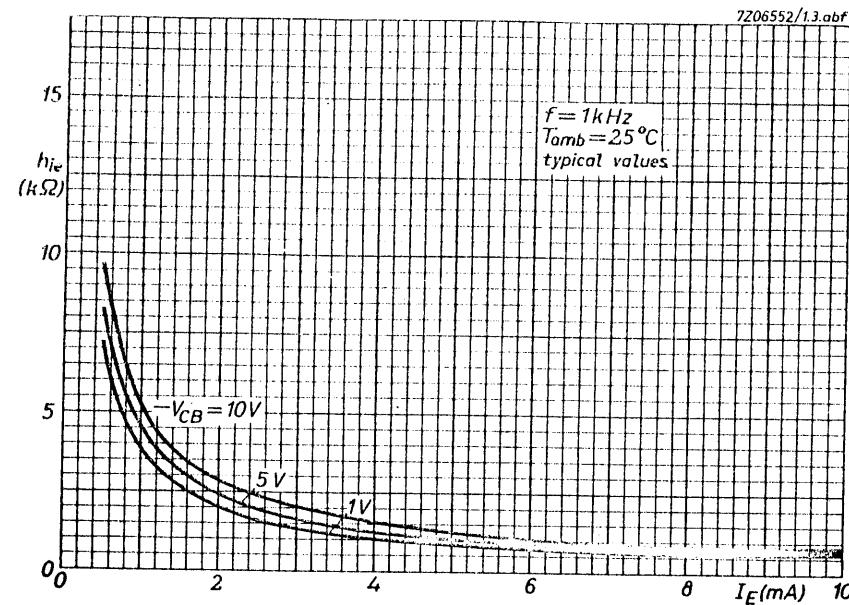
$$h_{fe} \quad \text{typ. } 180
130 \text{ to } 300$$

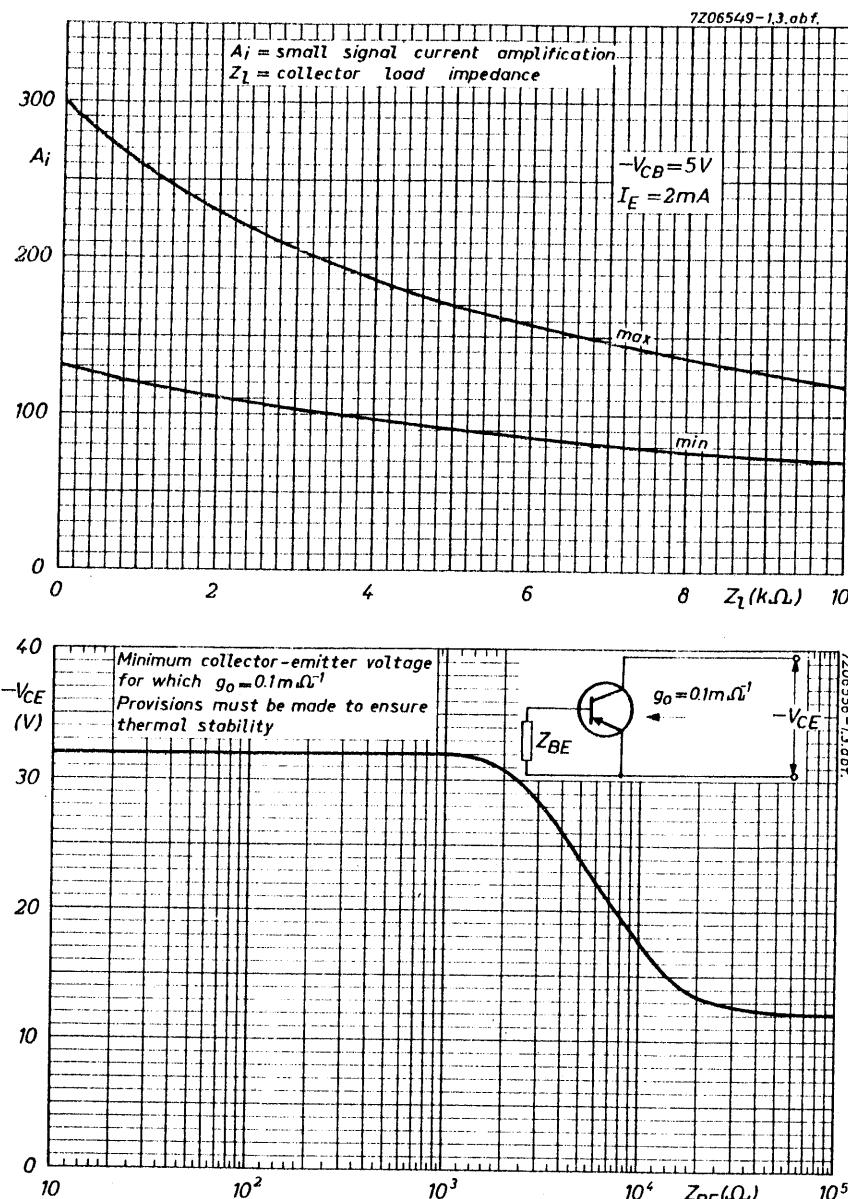
Output admittance

$$h_{oe} \quad \text{typ. } 100 \text{ } \mu\Omega^{-1}
< 170 \text{ } \mu\Omega^{-1}$$









GERMANIUM ALLOY TRANSISTOR

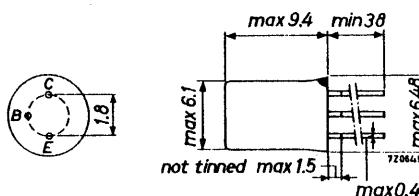
N-P-N transistor in a TO-1 metal envelope intended for use together with the p-n-p transistors AC128 or AC132 as matched pair in class B output or driver stages with complementary symmetry.

QUICK REFERENCE DATA		
Collector-base voltage (open emitter)	V_{CBO}	max. 32 V
Collector-emitter voltage (open base)	V_{CEO}	max. 12 V
Collector current (d.c.)	I_C	max. 500 mA
Total power dissipation up to $T_{amb} = 45^\circ\text{C}$ with cooling fin on a heatsink of at least 12.5 cm^2	P_{tot}	max. 340 mW
Junction temperature (incidentally)	T_j	max. 100 $^\circ\text{C}$
D.C. current gain at $T_{amb} = 25^\circ\text{C}$	h_{FE}	typ. 100
$I_C = 20 \text{ mA}; V_{CB} = 0$		
Transition frequency	f_T	typ. 2.5 MHz
$I_C = 10 \text{ mA}; V_{CB} = 2 \text{ V}$		

MECHANICAL DATA

TO-1

Dimensions in mm



The blue dot indicates the collector

Accessories see page 4

7Z3 1116

RATINGS (Limiting values)¹⁾Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	32	V
Collector-emitter voltage (open base)	V_{CEO}	max.	12	V
Collector-emitter voltage with $R_{BE} \leq 70 \Omega$	V_{CER}	max.	32	V
Emitter-base voltage (open collector)	V_{EBO}	max.	10	V

Currents

Collector current (d.c.)	I_C	max.	500	mA
Base current (d.c.)	I_B	max.	25	mA

Power dissipation

Total power dissipation up to $T_{amb} = 45^\circ\text{C}$
with cooling fin mounted on a heatsink of
at least 12.5 cm^2

P_{tot} max. 340 mW

Temperatures

Storage temperature	T_{stg}	-55 to +90	$^\circ\text{C}$
Junction temperature: continuous	T_j	max.	90 $^\circ\text{C}$
incidentally	T_j	max.	100 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th j-a}$	=	0.37	$^\circ\text{C}/\text{mW}$
From junction to case	$R_{th j-c}$	=	0.11	$^\circ\text{C}/\text{mW}$
From junction to ambient with cooling fin mounted on a heatsink of at least 12.5 cm^2	$R_{th j-a}$	=	0.16	$^\circ\text{C}/\text{mW}$

CHARACTERISTICS

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

Collector cut-off current

$I_E = 0; V_{CB} = 0.5 \text{ V}$ $I_{CBO} \leq 10 \mu\text{A}$

$I_E = 0; V_{CB} = 32 \text{ V}; T_j = 75^\circ\text{C}$ $I_{CBO} \leq 1100 \mu\text{A}$

Emitter cut-off current

$I_C = 0; V_{EB} = 5 \text{ V}; T_j = 75^\circ\text{C}$ $I_{EBO} \leq 550 \mu\text{A}$

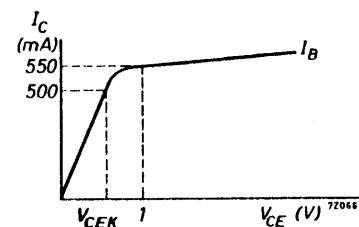
Emitter-base voltage

$-I_E = 2 \text{ mA}; V_{CB} = 5 \text{ V}$ $-V_{EB}$ typ. 120 mV

$-I_E = 500 \text{ mA}; V_{CB} = 0$ $-V_{EB}$ typ. 1200 mV

Knee voltage

$I_C = 500 \text{ mA}; I_B = \text{value for which}$
 $I_C = 550 \text{ mA}$ at $V_{CE} = 1 \text{ V}$ $V_{CEK} \leq 1 \text{ V}$

D.C. current gain

$I_C = 20 \text{ mA}; V_{CB} = 0$ β_{FE} typ. 100

$I_C = 50 \text{ mA}; V_{CB} = 0$ β_{FE} typ. 105

$I_C = 200 \text{ mA}; V_{CB} = 0$ β_{FE} typ. 90

$I_C = 500 \text{ mA}; V_{CB} = 0$ β_{FE} typ. 50

Collector capacitance at $f = 0.45 \text{ MHz}$

$I_E = I_e = 0; V_{CB} = 5 \text{ V}$ C_C typ. 70 pF

Feedback impedance at $f = 0.45 \text{ MHz}$

$I_C = 1 \text{ mA}; V_{CE} = 5 \text{ V}$ $|z_{rb}|$ typ. 70 Ω

¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0864

7Z3 0865

CHARACTERISTICS (continued) $T_{amb} = 25^\circ\text{C}$ unless otherwise specifiedTransition frequency $I_C = 10 \text{ mA}; V_{CE} = 2 \text{ V}$

f_T	> 1.5 MHz
	typ. 2.5 MHz

Cut-off frequency $I_C = 10 \text{ mA}; V_{CE} = 2 \text{ V}$

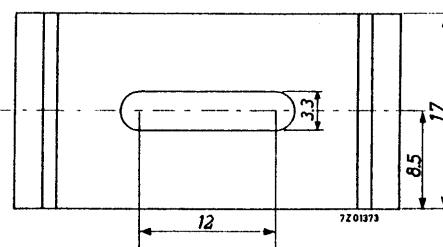
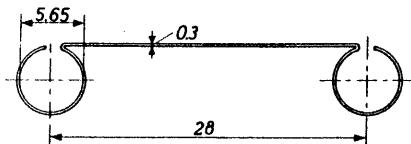
f_{hfe}	> 10 kHz
	typ. 20 kHz

Noise figure at $f = 1 \text{ kHz}$ $I_C = 0.5 \text{ mA}; V_{CE} = 5 \text{ V}; R_S = 500 \Omega$
Bandwidth = 200 Hz

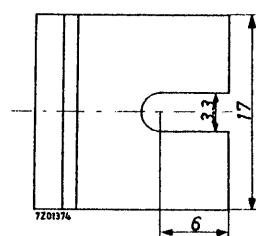
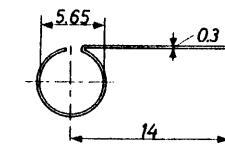
F	typ. 4 dB
	< 10 dB

D.C. current gain ratio of matched pair AC127/AC128 $|I_C| = 300 \text{ mA}; V_{CB} = 0$ h_{FE1}/h_{FE2} typ. 1.1

matched pair AC127/AC132

 $|I_C| = 50 \text{ mA}; V_{CB} = 0$ h_{FE1}/h_{FE2} typ. 1.1
< 1.25**ACCESSORIES**

Cooling fin: 56226



Cooling fin: 56227

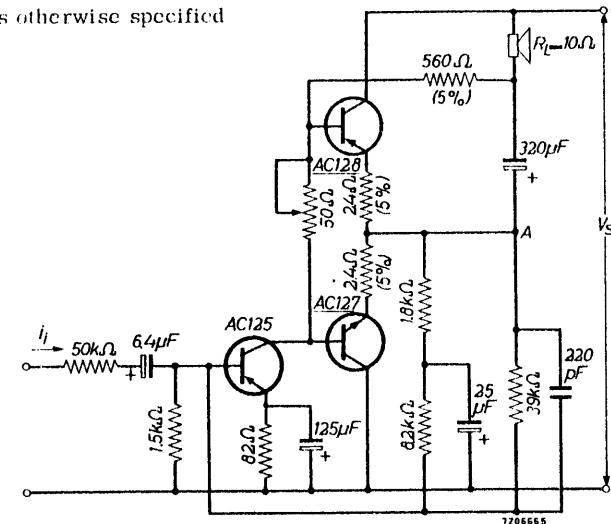
7Z3 0866

APPLICATION INFORMATION

1. AC127/AC128 as matched pair in a class B amplifier with complementary symmetry delivering an output power of 550 mW.

Tolerance of resistors:

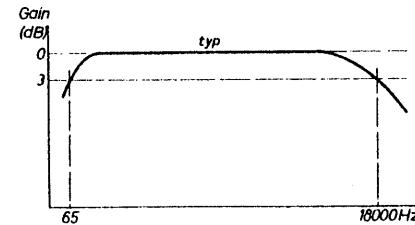
10% unless otherwise specified



Stable continuous operation is ensured up to an ambient temperature of 45°C provided each transistor is mounted with a cooling fin type No. 56226.

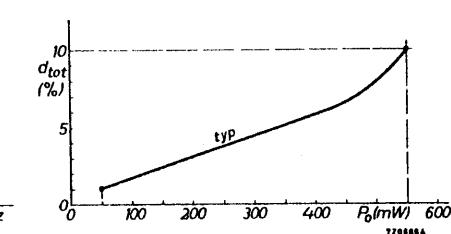
OPERATING CHARACTERISTICSSupply voltage $T_{amb} = 25^\circ\text{C}$ $V_S = 9 \text{ V}$ Output power ($d_{tot} = 10\%$) $P_O > 500 \text{ mW}$

typ. 550 mW



Typical frequency response

Typical distortion as a function of output power

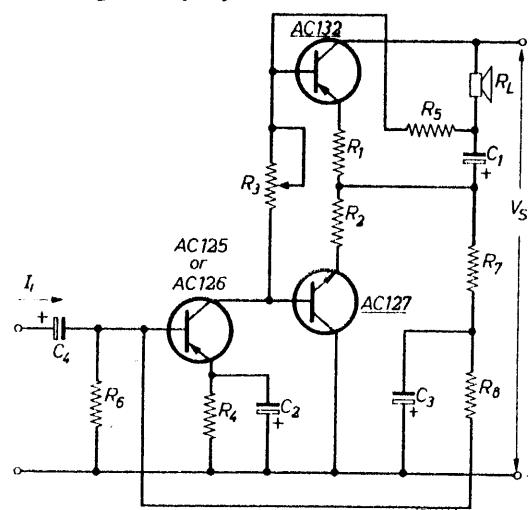


7Z3 0867

APPLICATION INFORMATION (continued)

Output stageEmitter current (zero signal) $|I_E| = 3 \text{ mA}$ Collector current (peak value) $|I_{CM}| \text{ typ. } 300 \text{ mA}$ Midtap voltage at point A $V_A \text{ typ. } 4.9 \text{ V}$ Driver stageCollector current $-I_C \text{ typ. } 7 \text{ mA}$ SensitivityInput current ($P_0 = 550 \text{ mW}$) $I_i(\text{rms}) \text{ typ. } 120 \mu\text{A}$ Input current ($P_0 = 50 \text{ mW}$) $I_i(\text{rms}) \text{ typ. } 35 \mu\text{A}$

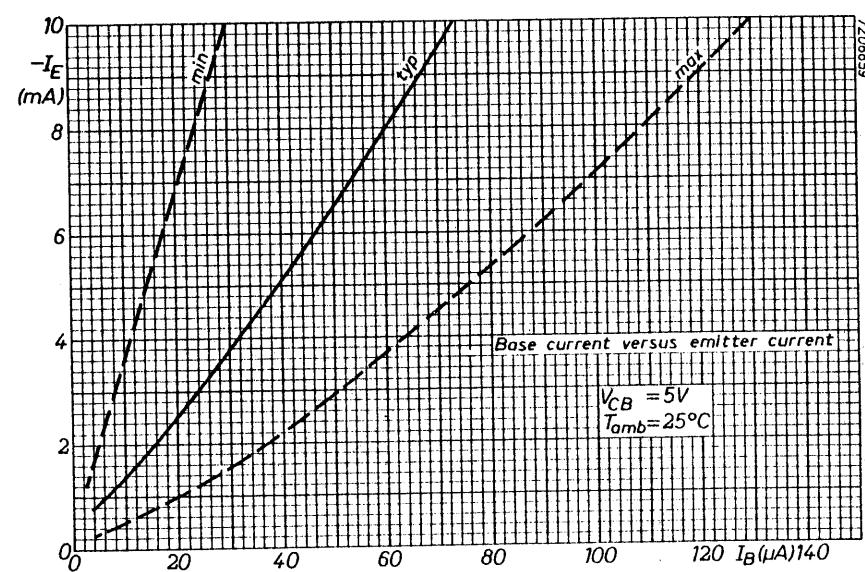
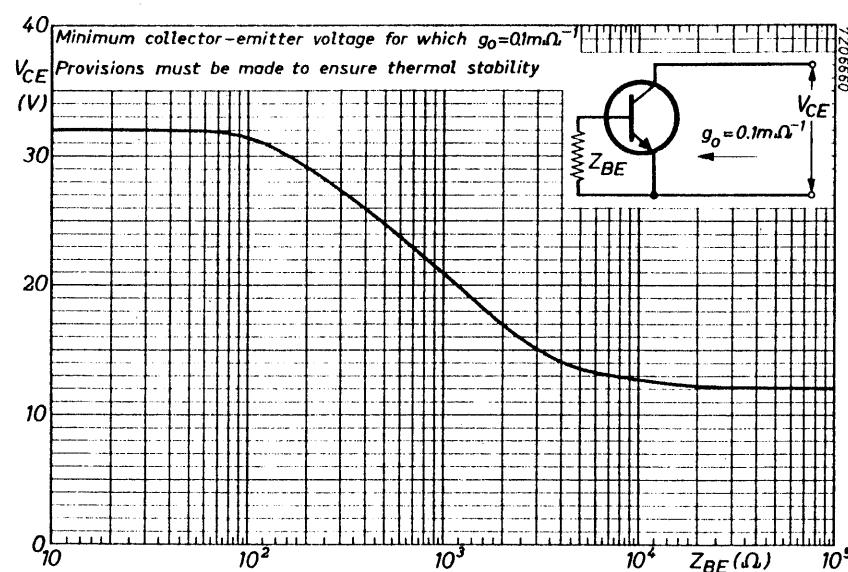
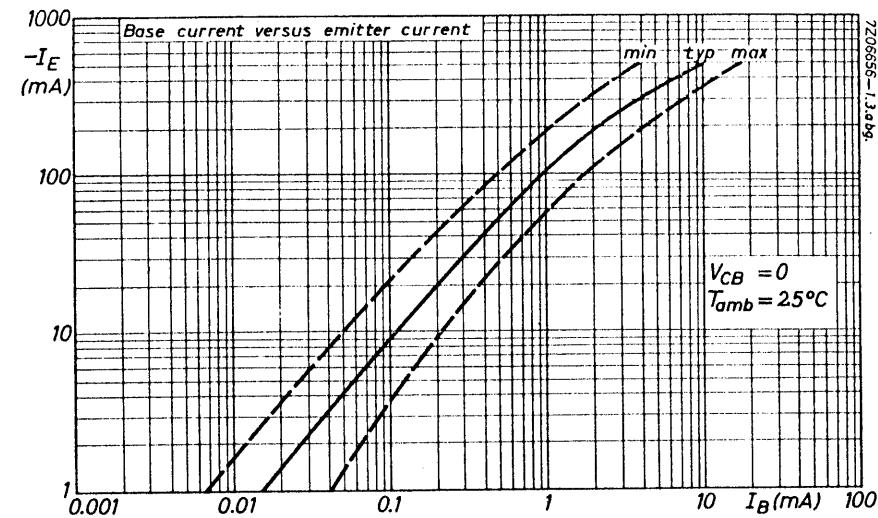
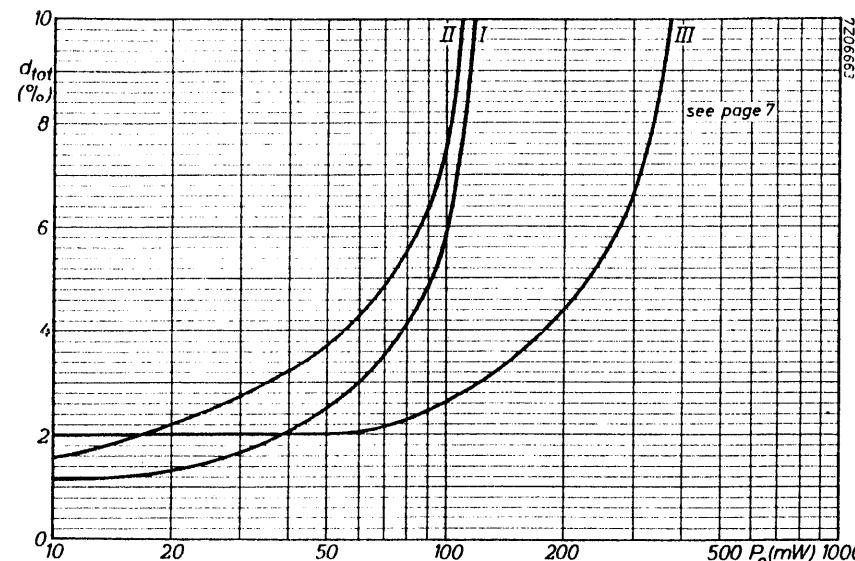
2. AC127/AC132 as matched pair in a class B amplifier with complementary symmetry delivering an output power of 370 mW.

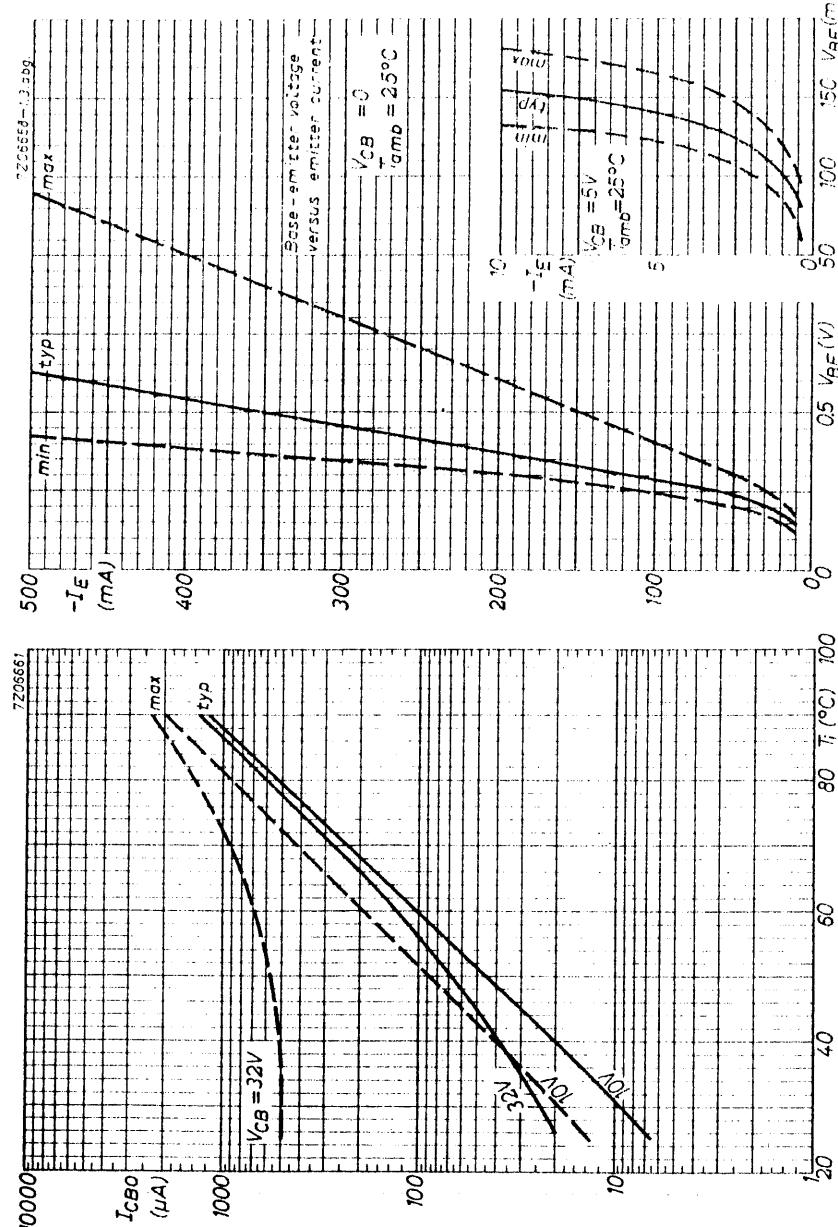


Stable continuous operation is ensured up to an ambient temperature of 45 °C, provided each transistor is mounted with a cooling fin.

APPLICATION INFORMATION (continued)

	I	II	III	V
Supply voltage V_S	≈ 6	9	9	V
Output power (at $d = 10\%$) P_0	typ. 115	110	370	mW
Distortion d_{tot}	> 105	100	300	mW
<u>Output stage</u>				
Emitter current (zero signal) $ I_{E1} $	≈ 2	2	2	mA
- $ I_{E2} $	≈ 2	2	2	mA
Emitter resistors R_1	≈ 3.3	4.7	3.9	Ω
R_2	≈ 3.3	4.7	3.9	Ω
R_3	< 100	250	50	Ω
Coupling capacitor C_1	≈ 200	64	320	μF
Load resistance R_L	≈ 25	70	15	Ω
Collector current (peak value) at P_0 max. $ I_{CM} $	typ. 90	50	200	mA
<u>Driver stage</u>				
Collector current $-I_C$	typ. 2.7	1.2	7.6	mA
Emitter resistor R_4	≈ 180	680	82	Ω
Collector resistor R_5	≈ 910	3300	510	Ω
Bias resistors R_6	≈ 4.7	6.8	1.8	kΩ
R_7	≈ 3.9	4.7	2.2	kΩ
R_8	≈ 15	24	6.8	kΩ
Decoupling capacitors C_2	≈ 40	25	120	μF
C_3	≈ 25	25	25	μF
C_4	≈ 6.4	6.4	6.4	μF
Input current at P_0 max. with AC125 $I_i(\text{rms})$	typ. 20	10	55	μA
with AC126 $I_i(\text{rms})$	typ. 15	8	40	μA
Input current at $P_0 = 50 \text{ mW}$ with AC125 $I_i(\text{rms})$	typ. 11.5	6	17	μA
with AC126 $I_i(\text{rms})$	typ. 9	4.5	12.5	μA
Total harmonic distortion at $P_0 = 50 \text{ mW}$ d_{tot}	typ. 2.5	3.8	2.0	%





GERMANIUM ALLOY TRANSISTOR

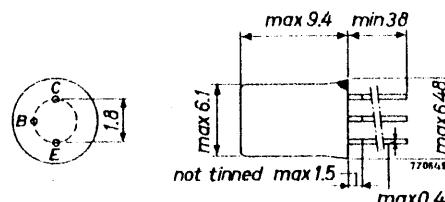
P-N-P transistor in a TO-1 metal envelope intended for use in class A or class B output stages with battery voltages up to 14 V and an output power of up to 4 W. Type 2-AC128 consists of 2 transistors AC128 selected for operation in a low distortion class B amplifier.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max. 32 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max. 16 V
Collector current (d.c.)	$-I_C$	max. 1 A
Total power dissipation up to $T_{amb} = 25^\circ\text{C}$ with cooling fin on a heatsink of at least 12.5 cm^2	P_{tot}	max. 1 W
Junction temperature (incidentally)	T_j	max. 100°C
D.C. current gain at $T_{amb} = 25^\circ\text{C}$ $-I_C = 50 \mu\text{A}; V_{CB} = 0$	h_{FE}	typ. 90 55 to 175
Transition frequency $-I_C = 10 \mu\text{A}; -V_{CE} = 2 \text{ V}$	f_T	typ. 1.5 MHz

MECHANICAL DATA

TO-1

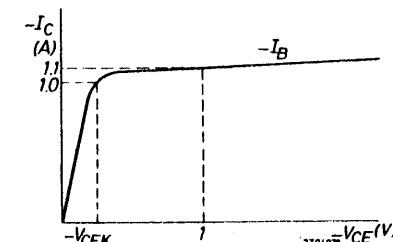


Dimensions in mm

The red dot indicates the collector

Accessories see page 4.

7Z3 0870

RATINGS (Limiting values)¹⁾VoltagesCollector-base voltage (open emitter) $-V_{CBO}$ max. 32 VCollector-emitter voltage (open base) $-V_{CEO}$ max. 16 VCollector-emitter voltage with $R_{BE} < 400 \Omega$ $-V_{CER}$ max. 32 VEmitter-base voltage (open collector) $-V_{EBO}$ max. 10 VCurrentsCollector current (d.c.) $-I_C$ max. 1000 mACollector current (peak value) $-I_{CM}$ max. 2000 mABase current (d.c.) $-I_B$ max. 40 mAPower dissipationTotal power dissipation up to $T_{amb} = 25^\circ\text{C}$
with cooling fin mounted on a heatsink of
at least 12.5 cm^2 P_{tot} max. 1000 mWTemperaturesStorage temperature T_{stg} -55 to +100 $^\circ\text{C}$ Junction temperature: continuous
incidentally T_j max. 90 $^\circ\text{C}$ **THERMAL RESISTANCE**From junction to ambient in free air $R_{th j-a}$ = 0.29 $^\circ\text{C}/\text{mW}$ From junction to case $R_{th j-c}$ = 0.04 $^\circ\text{C}/\text{mW}$ From junction to ambient with cooling
fin in free air $R_{th j-a}$ = 0.14 $^\circ\text{C}/\text{mW}$ From junction to ambient with cooling
fin mounted on a heatsink of at
least 12.5 cm^2 $R_{th j-a}$ = 0.08 $^\circ\text{C}/\text{mW}$ **CHARACTERISTICS**Collector cut-off current $I_E = 0; -V_{CB} = 10 \text{ V}$ $-I_{CBO}$ < 10 μA $I_E = 0; -V_{CB} = 32 \text{ V}$ $-I_{CBO}$ < 200 μA Emitter cut-off current $I_C = 0; -V_{EB} = 10 \text{ V}$ $-I_{EBO}$ < 200 μA $I_C = 0; -V_{EB} = 5 \text{ V}; T_j = 75^\circ\text{C}$ $-I_{EBO}$ < 500 μA Emitter-base voltage $I_E = 50 \text{ mA}; V_{CB} = 0$ V_{EB} < 300 mV $I_E = 300 \text{ mA}; V_{CB} = 0$ V_{EB} < 450 mVKnee voltage $-I_C = 1 \text{ A}; -I_B = \text{value for which}$ $-I_C = 1.1 \text{ A at } -V_{CE} = 1 \text{ V}$ $-V_{CEK}$ < 0.6 VD.C. current gain $-I_C = 50 \text{ mA}; V_{CB} = 0$ h_{FE} typ. 90 $-I_C = 300 \text{ mA}; V_{CB} = 0$ h_{FE} typ. 60 to 175 $-I_C = 1 \text{ A}; V_{CB} = 0$ h_{FE} typ. 80 $-I_C = 1 \text{ A}; V_{CB} = 0$ h_{FE} typ. 45 to 165Collector capacitance $I_E = I_c = 0; -V_{CB} = 5 \text{ V}$ C_c typ. 100 pFBase resistance $-I_C = 1 \text{ mA}; -V_{CE} = 5 \text{ V}$ $r_{bb'}$ typ. 25 Ω

7Z3 0872

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0871

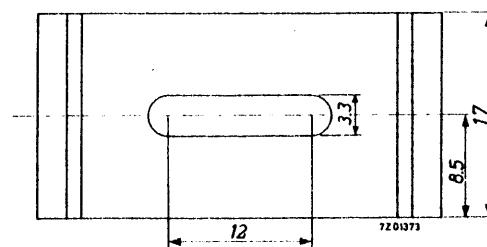
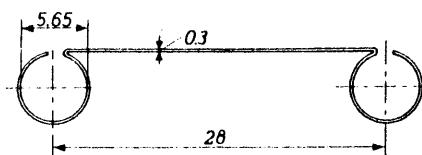
CHARACTERISTICS (continued) $T_{\text{amb}} = 25^{\circ}\text{C}$ unless otherwise specifiedTransition frequency $-I_C = 10 \text{ mA}; -V_{\text{CE}} = 2 \text{ V}$ $f_T > 1.0 \text{ MHz}$
typ. 1.5 MHzCut-off frequency $-I_C = 10 \text{ mA}; -V_{\text{CE}} = 2 \text{ V}$ $f_{\text{hfe}} > 10 \text{ kHz}$
typ. 15 kHzSmall signal current gain linearity

(see also page E)

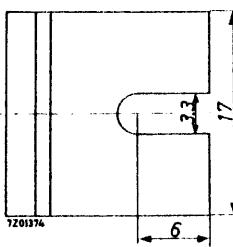
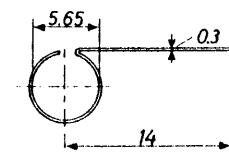
 $\lambda_{500} > 0.50 \text{ }^1)$
typ. 0.60 $\text{ }^1)$ D.C. current gain ratio of matched pair AC127/AC128 $|I_C| = 300 \text{ mA}; V_{\text{CB}} = 0$ $h_{\text{FE1}}/h_{\text{FE2}}$ typ. 1.1

14

matched pair 2-AC128

 $|I_C| = 50 \text{ mA}; V_{\text{CB}} = 0$ $h_{\text{FE1}}/h_{\text{FE2}}$ typ. 1.1 $|I_C| = 300 \text{ mA}; V_{\text{CB}} = 0$ $h_{\text{FE1}}/h_{\text{FE2}}$ < 1.25**ACCESSORIES**

Cooling fin: 56226



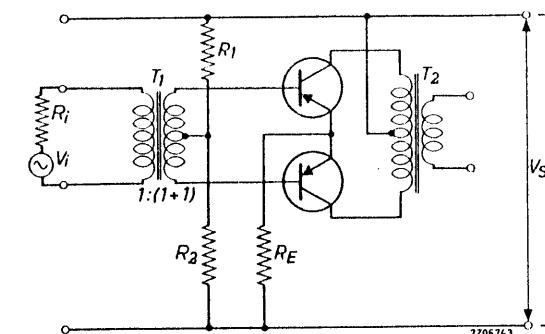
Cooling fin: 56227

 ${}^1) \lambda_{500} = \frac{A_i \text{ at } 500 \text{ mA}}{A_i \text{ max}}, \text{ where } A_i = \text{loaded small signal current amplification.}$

7Z3 0873

APPLICATION INFORMATION

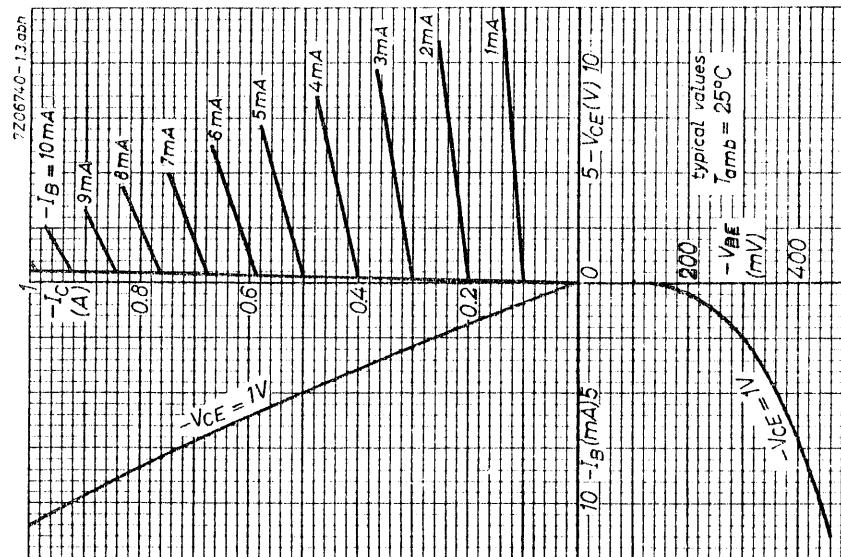
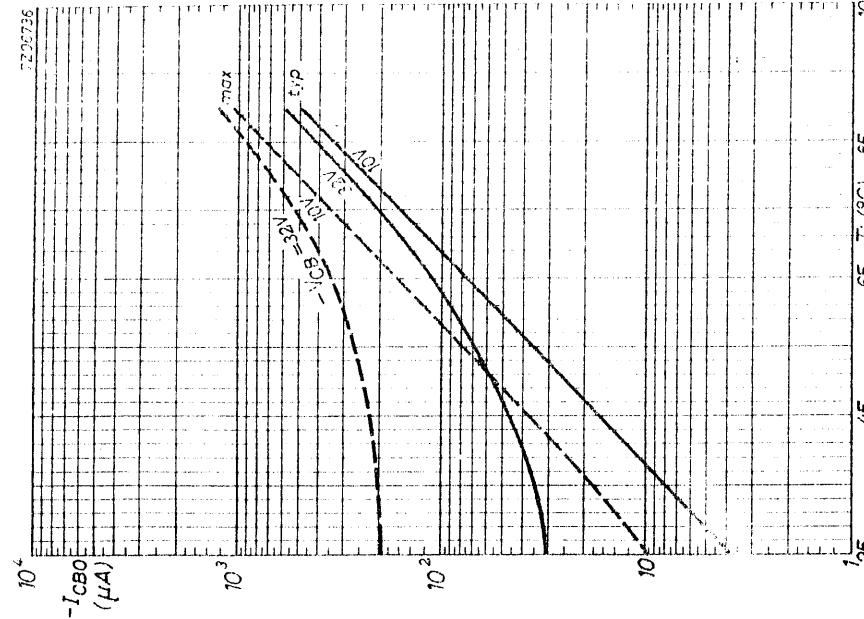
Class B operation with matched pair 2-AC128

To provide stability the total resistance in the base circuit of each transistor should be less than 100Ω .

	V_S	=	6	9	9	V
Ambient temperature	T_{amb}	up to	55	55	45	$^{\circ}\text{C}$
Emitter current (zero signal)	I_E	=	2x3	2x3	2x3	mA
Bias resistor ${}^1)$	R_1	=	2.0	2.2	3.5 ${}^2)$	k Ω
Bias resistor ${}^1)$	R_2	=	47	39	3 ${}^3)$	Ω
Common emitter resistor	R_E	=	2.2	3.9	1.5	Ω
Input (source) resistance	R_i	=	1.5	1.5	1.0	k Ω
Load resistance	$R_{cc\sim}$	=	65	98	62	Ω
Dissipation (two transistors) ${}^4)$	P_{tot}	typ.	2x0.425	2x0.65	2x1.05	W
Power delivered to transformer	P_O	typ.	0.75	1.1	1.9	W
Collector current (peak value)						
at P_O max	$-I_{CM}$	typ.	300	300	500	mA
Collector current at P_O max	$-I_C$	typ.	2x95	2x95	2x150	mA
Input voltage at P_O max	V_i	typ.	5.5	6.0	6.6 ${}^5)$	V
Total harmonic distortion						
at P_O max	d_{tot}	typ.	3.5	4.0	5.5	%
Input voltage at $P_O = 50 \text{ mW}$	V_i	typ.	1.6	1.4	1.1 ${}^5)$	V
Total harmonic distortion						
at $P_O = 50 \text{ mW}$	d_{tot}	typ.	2.0	2.0	2.5	%

 ${}^1)$ Tolerance of bias resistors: 5 % ${}^2)$ Variable resistor ${}^3)$ This resistance is composed of a 68Ω resistor in parallel with a 130Ω NTC resistor. Code number 2322 610 12131. ${}^4)$ Mounted on cooling fin 56227 at T_{amb} up to 20°C . ${}^5)$ Losses in the driver transformer are not taken into account.

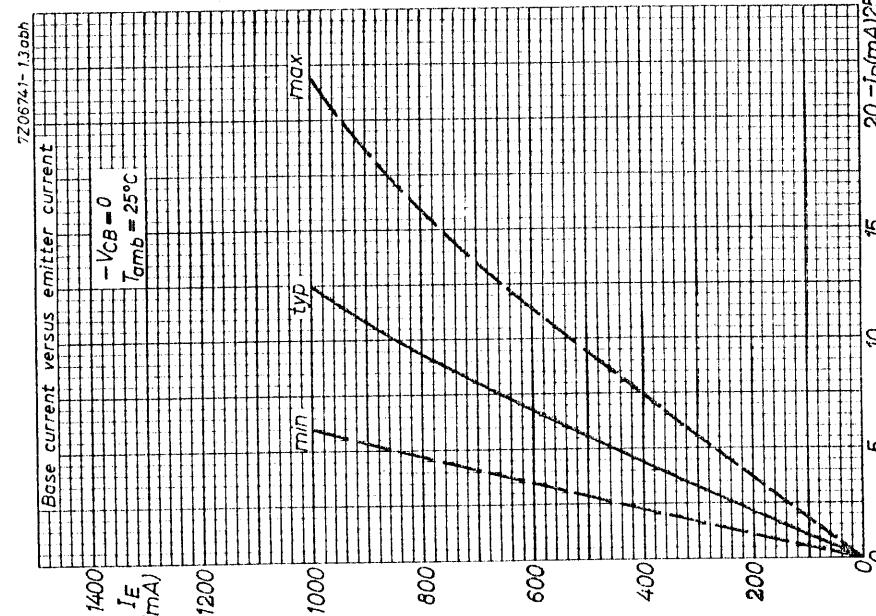
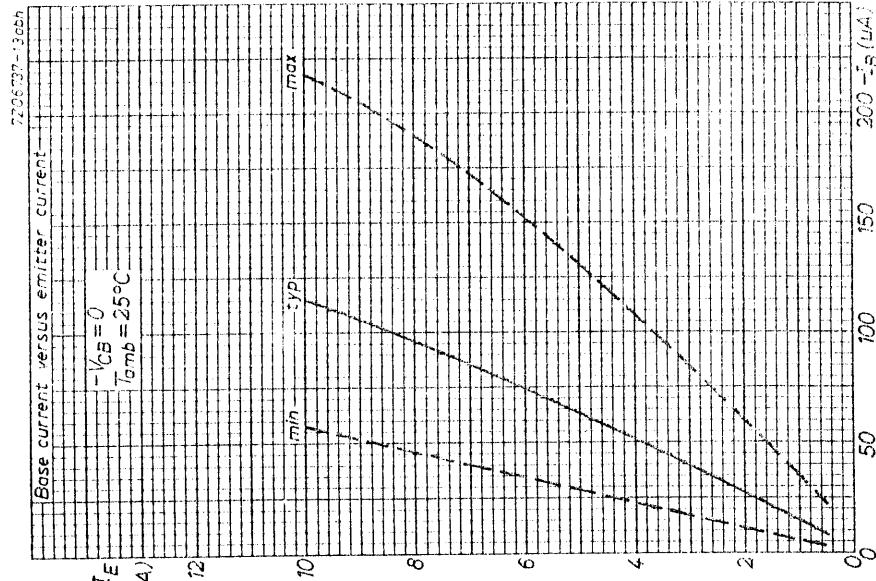
7Z3 0874

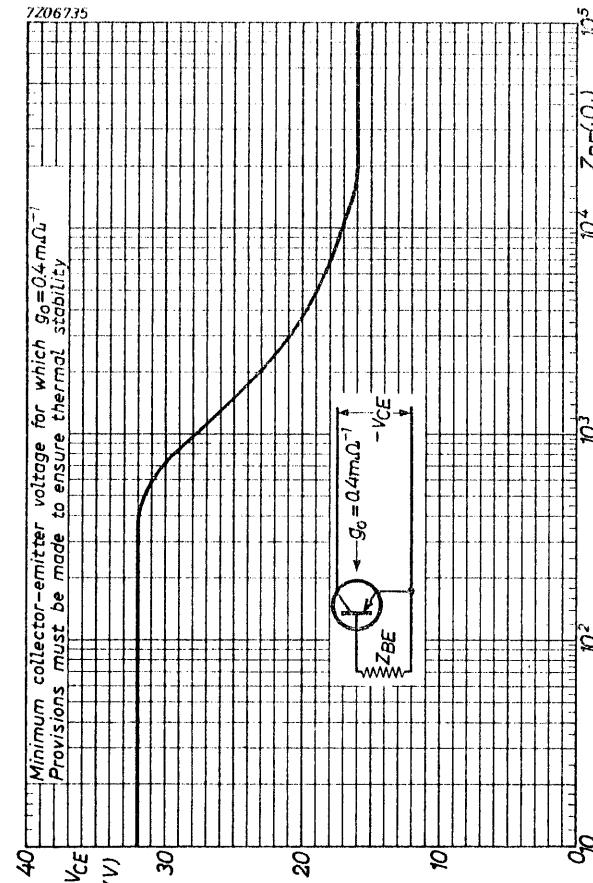
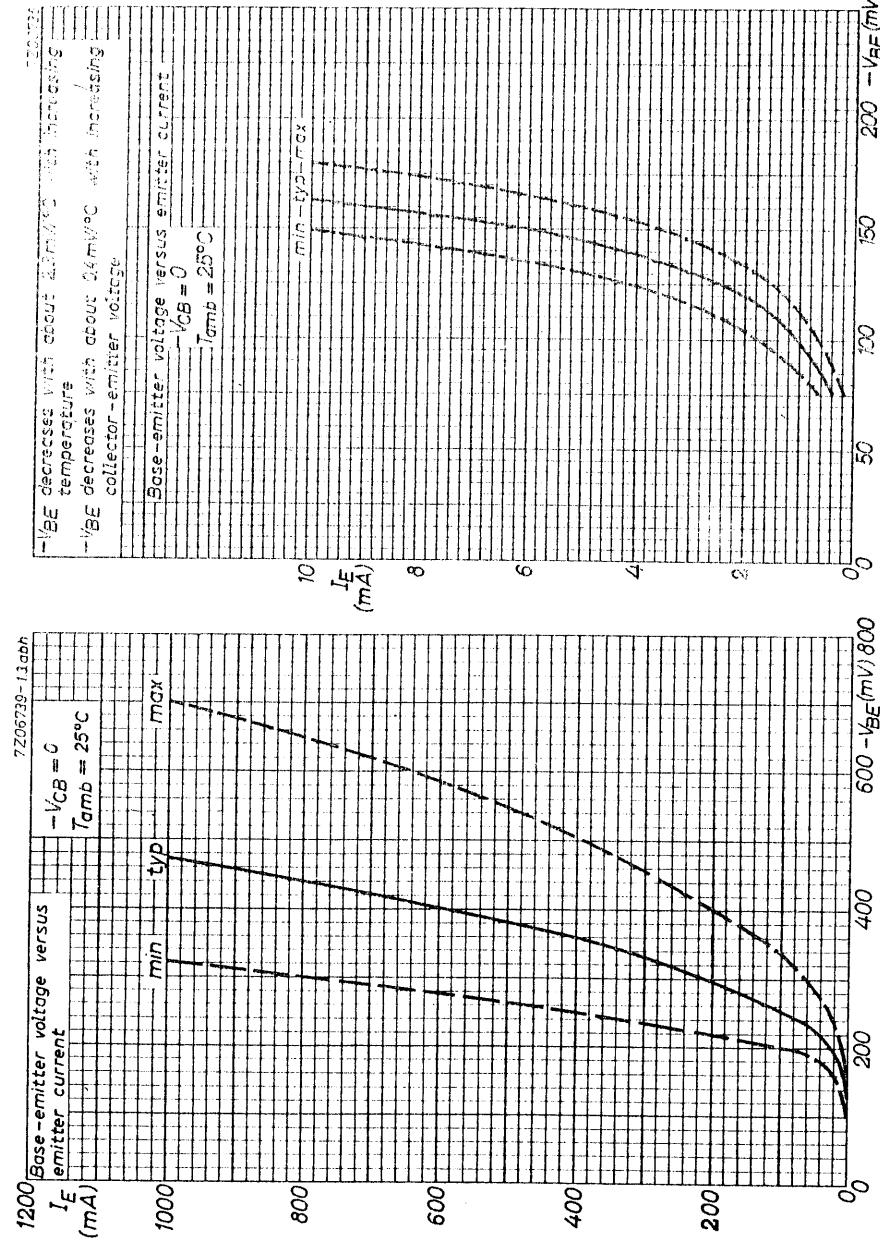


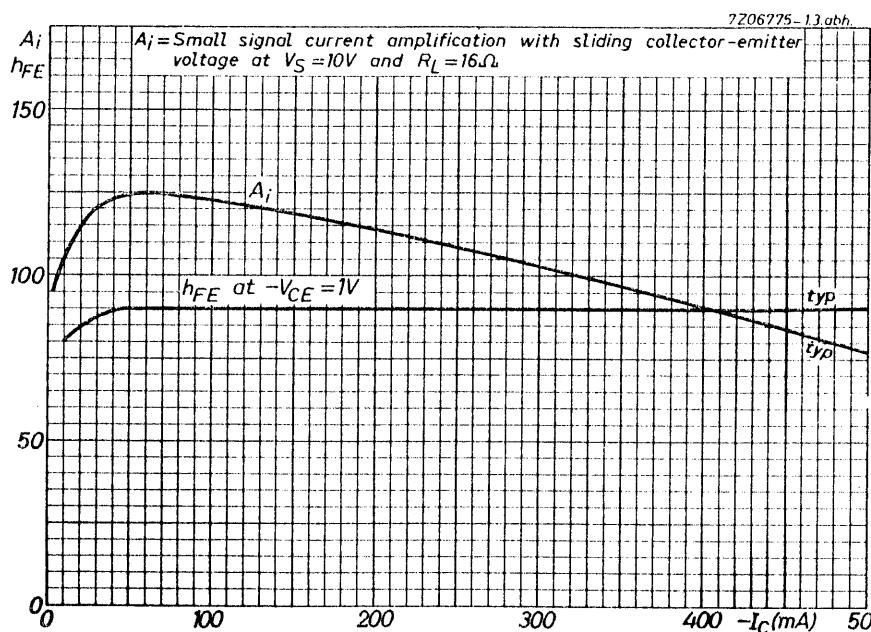
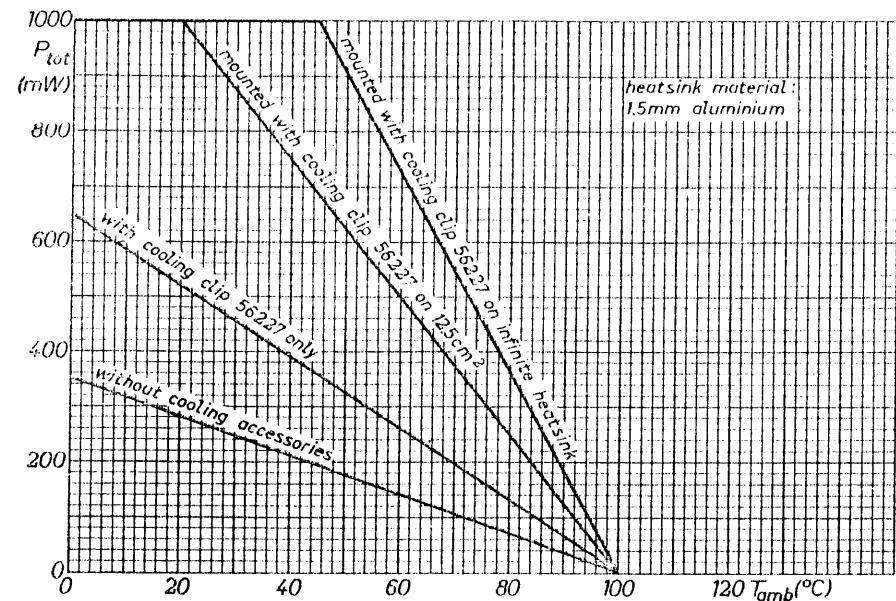
106

10.10.1966

107







SYMMETRICAL GERMANIUM TRANSISTOR

N-P-N transistor in a TO-1 metal envelope. The AC130 is primarily intended for use in horizontal deflection synchronization circuits.

RATINGS Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

Collector-base voltage (open emitter)	V_{CBO}	max. 20 V
Collector-emitter voltage (open base)	V_{CEO}	max. 10 V
Collector-emitter voltage with $R_{BE} \leq 10\text{ k}\Omega$	V_{CER}	max. 15 V
Collector current (d.c.)	I_C	max. 100 mA
Total power dissipation up to $T_{amb} = 25^\circ\text{C}$	P_{tot}	max. 145 mW
Junction temperature	T_J	max. 90 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to ambient in free air

$$R_{th j-a} = 0.45 \text{ } ^\circ\text{C/mW}$$

CHARACTERISTICS

Saturation voltages

$I_C = 10 \text{ mA}; I_B = 1 \text{ mA}$	V_{CESat}	typ. 15 mV
	V_{BESat}	typ. 245 mV

D.C. current gain

$I_C = 10 \text{ mA}; V_{CE} = 1 \text{ V}$	h_{FE}	> 25
		typ. 65

Ratio between h_{FE} and h_{FC}
for each individual transistor

h_{FE}	typ. 1
h_{FC}	0.5 to 2

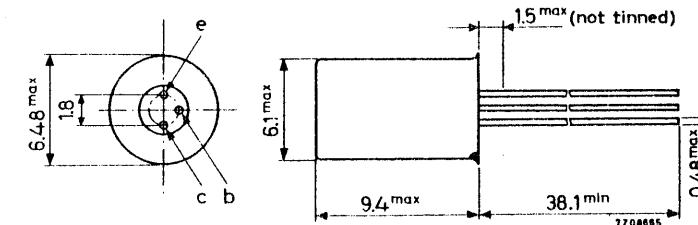
Transition frequency

$I_C = 10 \text{ mA}; V_{CE} = 1 \text{ V}$	f_T	> 2 MHz
---	-------	---------

MECHANICAL DATA

TO-1

Dimensions in mm



The coloured dot indicates the collector.

Because of its very good symmetrical properties the collector and emitter can be connected interchangeably.

GERMANIUM ALLOY TRANSISTOR

P-N-P transistor in a TO-1 metal envelope intended for use together with the n-p-n transistor AC127 as matched pair AC127/AC132 in class B output stages with complementary symmetry.

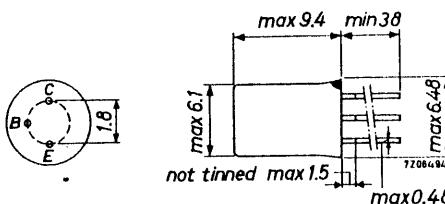
Type 2-AC132 consists of 2 transistors AC132 selected for operation in class B output stages.

QUICK REFERENCE DATA		
Collector-base voltage (open emitter)	$-V_{CBO}$	max. 32 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max. 12 V
Collector current (d.c.)	$-I_C$	max. 200 mA
Total power dissipation up to $T_{amb} = 45^{\circ}\text{C}$ with cooling fin on a heatsink of at least 12.5 cm^2	P_{tot}	max. 500 mW
Junction temperature	T_j	max. 90°C
D.C. current gain at $T_{amb} = 25^{\circ}\text{C}$ $-I_C = 20 \text{ mA}; V_{CB} = 0$	h_{FE}	typ. 135
Transition frequency $-I_C = 10 \text{ mA}; -V_{CE} = 2 \text{ V}$	f_T	typ. 2.0 MHz

MECHANICAL DATA

Dimensions in mm

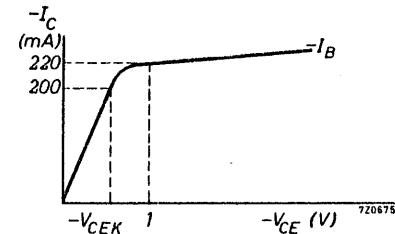
TO-1



The red dot indicates the collector

Accessories see page 4.

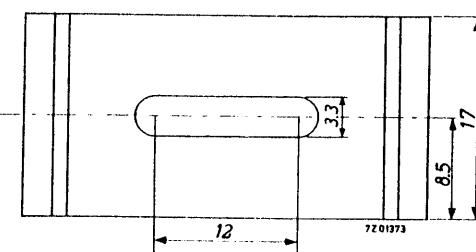
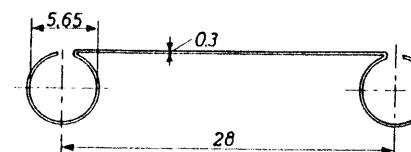
7Z3 0875

RATINGS (Limiting values)¹⁾VoltagesCollector-base voltage (open emitter) $-V_{CBO}$ max. 32 VCollector-emitter voltage (open base) $-V_{CBO}$ max. 12 VCollector-emitter voltage with $R_{BE} < 1 \text{ k}\Omega$ $-V_{CER}$ max. 32 VEmitter-base voltage (open collector) $-V_{EBO}$ max. 10 VCurrentsCollector current (d.c.) $-I_C$ max. 200 mABase current (d.c.) $-I_B$ max. 10 mAPower dissipationTotal power dissipation up to $T_{amb} = 45^\circ\text{C}$
with cooling fin mounted on a heatsink of
at least 12.5 cm^2 P_{tot} max. 500 mWTemperaturesStorage temperature T_{stg} -55 to +70 $^\circ\text{C}$ Junction temperature T_j max. 90 $^\circ\text{C}$ THERMAL RESISTANCEFrom junction to ambient in free air $R_{th j-a}$ = 0.30 $^\circ\text{C}/\text{mW}$ From junction to case $R_{th j-c}$ = 0.05 $^\circ\text{C}/\text{mW}$ From junction to ambient with cooling
fin mounted on a heatsink of at
least 12.5 cm^2 $R_{th j-a}$ = 0.09 $^\circ\text{C}/\text{mW}$ CHARACTERISTICSCollector cut-off current $I_E = 0; -V_{CB} = 0.5 \text{ V}$ $-I_{CBO}$ < 10 μA $I_E = 0; -V_{CB} = 32 \text{ V}; T_j = 75^\circ\text{C}$ $-I_{CBO}$ < 800 μA Emitter cut-off current $I_C = 0; -V_{EB} = 5 \text{ V}; T_j = 75^\circ\text{C}$ $-I_{EBO}$ < 550 μA Emitter-base voltage $I_E = 2 \text{ mA}; -V_{CB} = 5 \text{ V}$ V_{EB} typ. 105 mV $I_E = 200 \text{ mA}; -V_{CB} = 0$ V_{EB} < 550 mVKnee voltage $-I_C = 200 \text{ mA}; -I_B = \text{value for which}$
 $-I_C = 220 \text{ mA at } -V_{CE} = 1 \text{ V}$ $-V_{CEK}$ < 350 mVD.C. current gain $-I_C = 20 \text{ mA}; V_{CB} = 0$ h_{FE} typ. 135 $-I_C = 50 \text{ mA}; V_{CB} = 0$ h_{FE} typ. 115 $-I_C = 200 \text{ mA}; V_{CB} = 0$ h_{FE} typ. 70Collector capacitance at $f = 0.45 \text{ MHz}$ $I_E = I_e = 0; -V_{CB} = 5 \text{ V}$ C_c typ. 40 pFFeedback impedance at $f = 0.45 \text{ MHz}$ $-I_C = 1 \text{ mA}; -V_{CE} = 5 \text{ V}$ $|z_{rb}|$ typ. 90 Ω

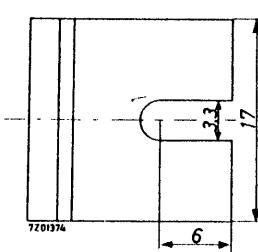
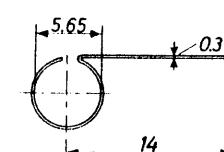
1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

7Z3 0876

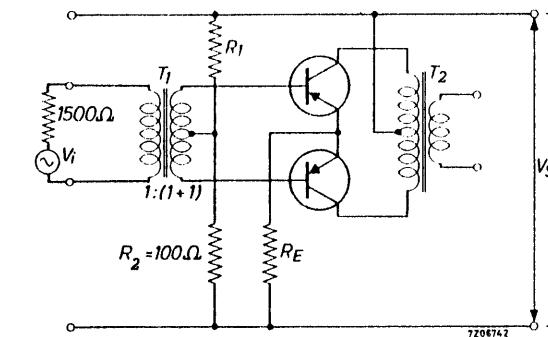
7Z3 0877

CHARACTERISTICS (continued) $T_{\text{amb}} = 25^{\circ}\text{C}$ unless otherwise specifiedTransition frequency $-I_C = 10 \text{ mA}; -V_{\text{CE}} = 2 \text{ V}$ f_T typ. 1.3 MHz
typ. 2.0 MHz Cut-off frequency $-I_C = 10 \text{ mA}; -V_{\text{CE}} = 2 \text{ V}$ f_{hfe} typ. 10 kHz
typ. 17 kHz Noise figure at $f = 1 \text{ kHz}$ $-I_C = 0.5 \text{ mA}; -V_{\text{CE}} = 5 \text{ V}; R_S = 500 \Omega$ Bandwidth $\approx 200 \text{ Hz}$ F typ. 4 dB
< 10 dB D.C. current gain ratio of matched pair AC127/AC132 $|I_C| = 50 \text{ mA}; V_{\text{CB}} = 0$ $h_{\text{FE}1}/h_{\text{FE}2}$ typ. 1.1
< 1.25matched pair 2-AC132 $|I_C| = 20 \text{ mA}; V_{\text{CB}} = 0$ $h_{\text{FE}1}/h_{\text{FE}2}$ typ. 1.1
< 1.25 $|I_C| = 200 \text{ mA}; V_{\text{CB}} = 0$ $h_{\text{FE}1}/h_{\text{FE}2}$ typ. 1.1
< 1.25ACCESSORIES

Cooling fin: 56226

Cooling fin: 56227
7Z3 0878APPLICATION INFORMATION

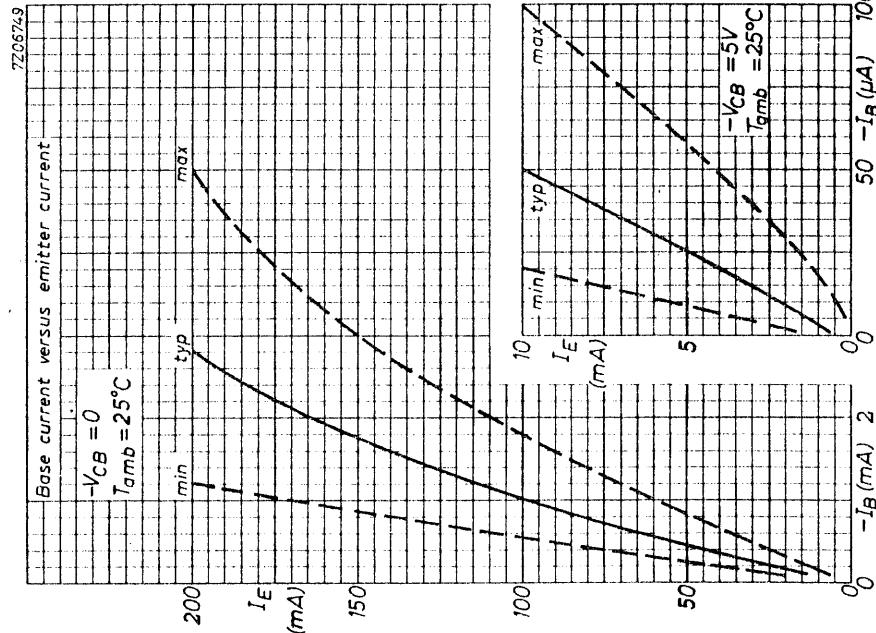
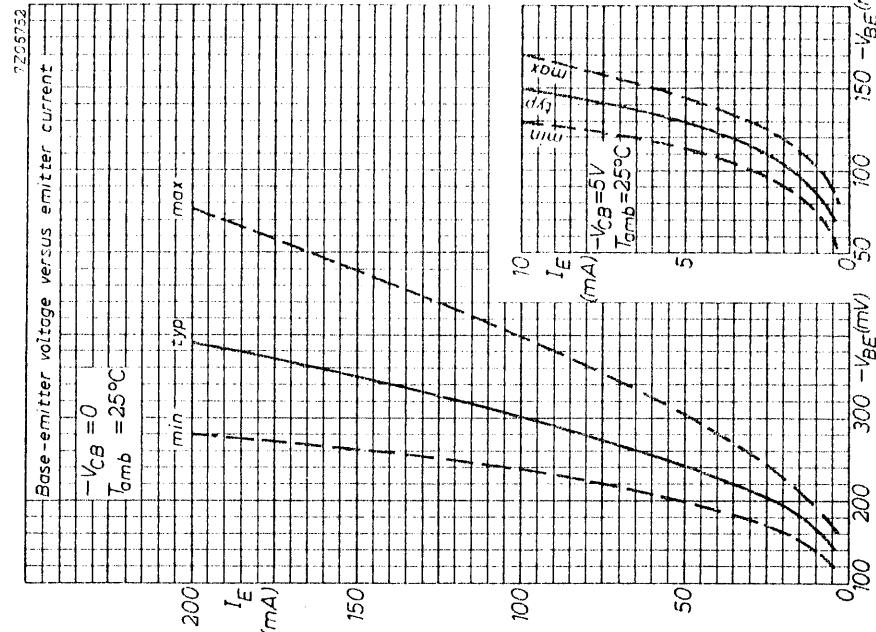
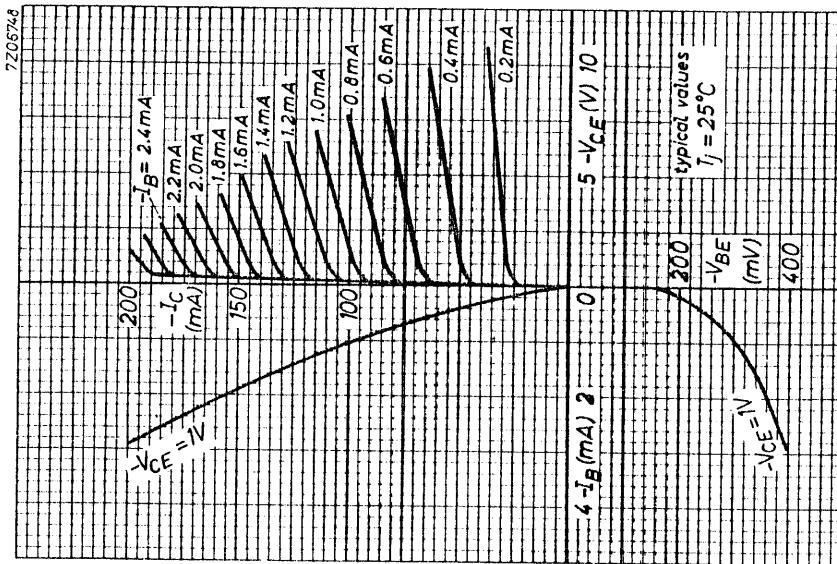
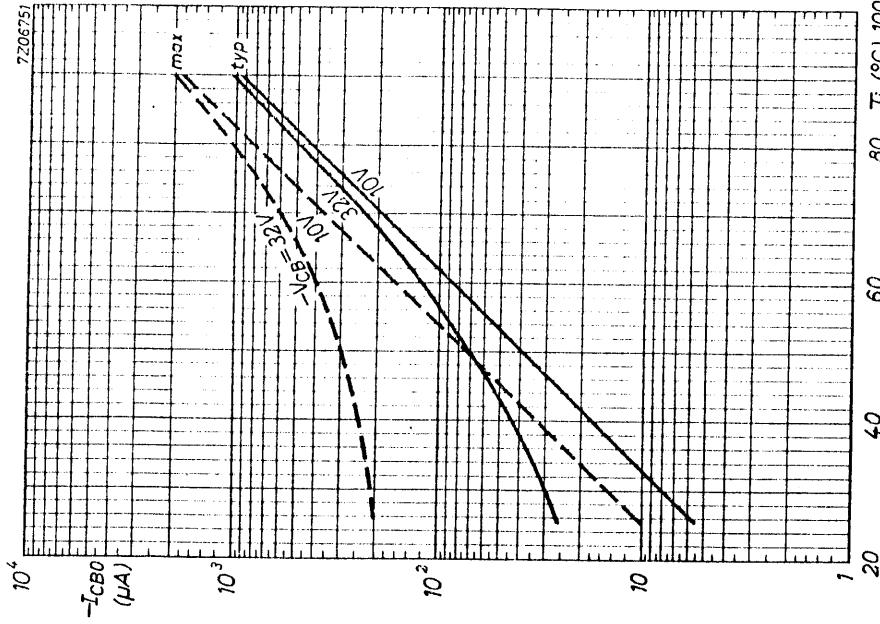
Audio frequency amplifier with matched pair 2-AC132 in class B operation.

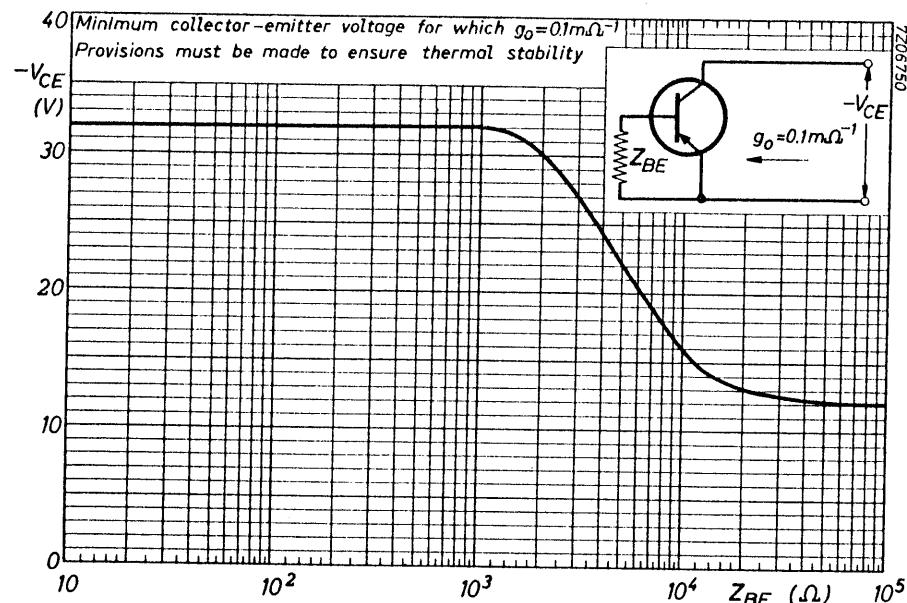


The transistors may be used without cooling fins or heatsinks.

Stable continuous operation is ensured at an ambient temperature of up to 45°C .CHARACTERISTICS $T_{\text{amb}} = 25^{\circ}\text{C}$

Supply voltage	V_S	=	6	9	V
Emitter current (zero signal)	I_E	=	2×1.5	2×1.5	mA
Bias resistor	R_1	=	5.6	6.8	kΩ
Common emitter resistor	R_E	=	5	14	Ω
Load resistance	$R_{CC\sim}$	=	160	292	Ω
Total power dissipation	P_{tot}	typ.	2×180	2×220	mW
Power delivered to transformer output	P_o	typ.	310	365	mW
Collector current (peak value) at P_o max	$-I_{CM}$	typ.	125	100	mA
Collector current at P_o max	$-I_C$	typ.	40	32	mA
Input voltage at P_o max	V_i	typ.	4	3.8	V
Total harmonic distortion at P_o max	d_{tot}	typ.	7	6	%
Input voltage at $P_o = 50 \text{ mW}$	V_i	typ.	1.40	1.35	V
Total harmonic distortion at $P_o = 50 \text{ mW}$	d_{tot}	typ.	2.5	3.0	%





GERMANIUM ALLOYED MEDIUM POWER TRANSISTORS

The AC187 is a n-p-n audio transistor in a TO-1 metal envelope.

The AC187 is primarily intended for use together with the p-n-p medium power transistor AC188 as matched pair AC187/AC188 to about 3 W complementary symmetry class B output stages.

The AC187/01 is electrically equivalent to the AC187, constructed integrally with a heat conducting block, which gives better heat transfer.

The thermal resistance from junction to heatsink shows an improvement ($\approx 10^\circ\text{C/W}$) as compared with that obtained with the AC187 when using heat conducting clip 56227.

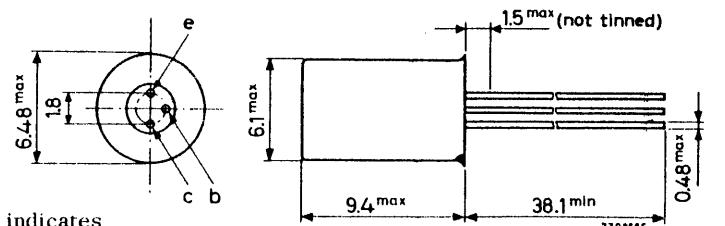
The AC187/01 is also available as matched pair with the AC188/01.

QUICK REFERENCE DATA		
Collector-base voltage (open emitter)	V_{CBO}	max. 25 V
Collector-emitter voltage (open base)	V_{CEO}	max. 15 V
Collector current (peak value)	I_{CM}	max. 2 A
Total power dissipation up to $T_{amb} = 46^\circ\text{C}$	P_{tot}	max. 0.8 W
Junction temperature	T_j	max. 90 $^\circ\text{C}$
D.C. current gain at $T_j = 25^\circ\text{C}$ $I_C = 300 \text{ mA}; V_{CE} = 1 \text{ V}$	h_{FE}	100 to 500
Cut-off frequency $I_C = 10 \text{ mA}; V_{CE} = 2 \text{ V}$	f_{hfe}	typ. 20 kHz

MECHANICAL DATA

AC187

TO-1

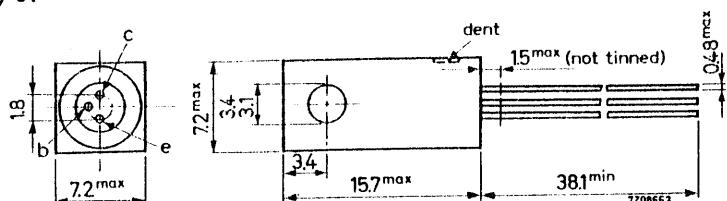


The coloured dot indicates
the collector

Accessories available: 56200; 56208; 56209; 56210; 56226; 56227

MECHANICAL DATA (continued)

AC187/01



The dent indicates the collector

RATINGS (Limiting values)¹⁾

Voltages

Collector-base voltage (open emitter) V_{CBO} max. 25 V

Collector-emitter voltage (open base) V_{CEO} max. 15 V

Collector-emitter voltage
 $I_C \leq 600 \text{ mA}; R_{BE} \leq 1 \Omega$ V_{CER} max. 18 V

Emitter-base voltage (open collector) V_{EBO} max. 10 V

Currents

Collector current (d.c. or average over
any 50 ms period) I_C max. 1 A

Collector current (peak value) I_{CM} max. 2 A

Power dissipation

Total power dissipation up to $T_{amb} = 46^\circ\text{C}$ ²⁾ P_{tot} max. 0.8 W

Temperatures

Storage temperature T_{stg} -55 to +75 °C

Junction temperature T_j max. 90 °C

Dimensions in mm

THERMAL RESISTANCE

From junction to ambient in free air

without cooling clip

with cooling clip 56227

with cooling clip 56227 on

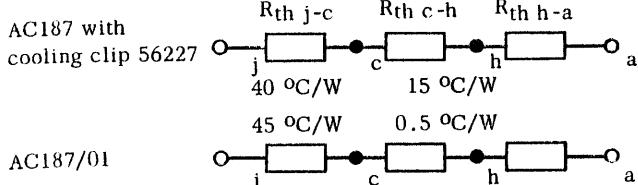
1.5 mm blackened Al. heatsink of 12.5 cm^2

with cooling clip 56227 on infinite heatsink

AC187 AC187/01

AC187	AC187/01
$R_{th j-a} = 290$	180 °C/W
$R_{th j-a} = 140$	°C/W
$R_{th j-a} = 80$	70.5 °C/W
$R_{th j-a} = 55$	°C/W
$R_{th j-c} = 40$	45 °C/W

From junction to case



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

CHARACTERISTICS

Collector cut-off current

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

$I_E = 0; V_{CB} = 25 \text{ V}; T_j = 90^\circ\text{C}$

$-V_{BE} = 1.0 \text{ V}; V_{CE} = 25 \text{ V}$

I_{CBO} typ. 15 μA

I_{CBO} < 100 μA

I_{CEX} < 2.5 mA

Emitter cut-off current

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

I_{EBO} typ. 15 μA

I_{EBO} < 100 μA

$I_C = 0; V_{EB} = 10 \text{ V}; T_j = 90^\circ\text{C}$

I_{EBO} typ. 1.2 mA

I_{EBO} < 2.5 mA

Base-emitter voltage

$I_C = 5 \text{ mA}; V_{BE} = 10 \text{ V}$

V_{BE} 95 to 135 mV

$I_C = 300 \text{ mA}; V_{BE} = 1 \text{ V}$

V_{BE} < 550 mV

Emitter-base floating voltage

$I_E = 0; V_{CB} = 25 \text{ V}; T_j = 90^\circ\text{C}$

V_{EBfl} < 400 mV

¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

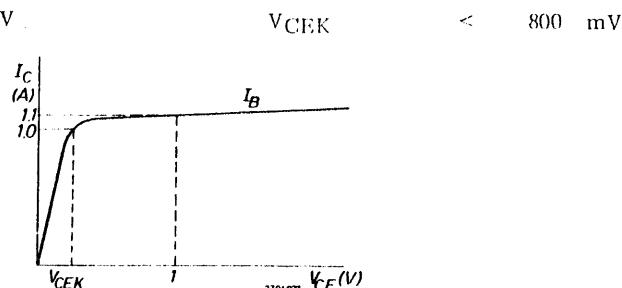
²⁾ The allowable peak power in class B speech and musical driven amplifiers is 1.1 W

CHARACTERISTICS (continued)

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

Knee voltage

$I_C = 1 \text{ A}$; $I_B = \text{value for which}$
 $I_C = 1.1 \text{ A at } V_{CE} = 1 \text{ V}$



D.C. current gain

$I_C = 5 \text{ mA}; V_{CE} = 10 \text{ V}$

$h_{FE} > 70$

$I_C = 300 \text{ mA}; V_{CE} = 1 \text{ V}$

$h_{FE} \text{ typ. } 200$
 $100 \text{ to } 500$

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

$h_{FE} > 50$

Collector capacitance at $f = 450 \text{ kHz}$

$I_E = I_e = 0; V_{CB} = 5 \text{ V}$

$C_c \text{ typ. } 150 \text{ pF}$
 $< 180 \text{ pF}$

Transition frequency

$I_C = 10 \text{ mA}; V_{CE} = 2 \text{ V}$

$f_T > 1 \text{ MHz}$
 $\text{typ. } 5 \text{ MHz}$

Cut-off frequency

$I_C = 10 \text{ mA}; V_{CE} = 2 \text{ V}$

$f_{hfe} \text{ typ. } 20 \text{ kHz}$

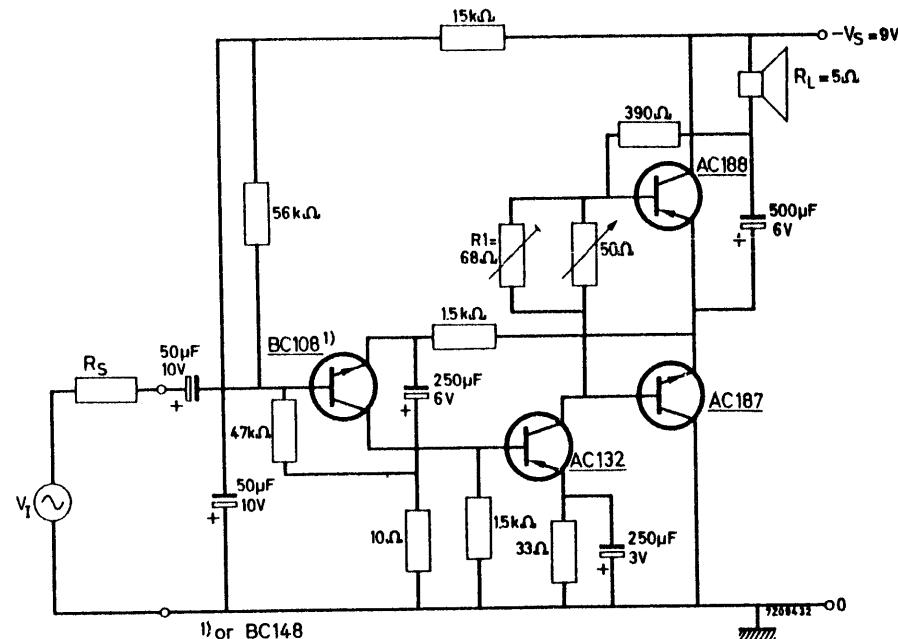
D.C. current gain ratio of matched pair AC187/AC188

$|I_C| = 500 \text{ mA}; |V_{CE}| = 1 \text{ V}$

$h_{FE1}/h_{FE2} < 1 : 1.25$

APPLICATION INFORMATION

1.5 W transformerless audio frequency amplifier with matched pair AC187/AC188 in complementary symmetry class B output stage up to $T_{amb} = 45^\circ\text{C}$.



Typical input requirements
for an output power of 50 mW

$V_i(\text{rms}) = 4 \text{ mV}; I_i(\text{rms}) = 0.12 \mu\text{A};$
 $R_i = 33 \text{ k}\Omega$

Typical input requirements
for an output power of 1.5 W

$V_i(\text{rms}) = 22 \text{ mV}; I_i(\text{rms}) = 0.66 \mu\text{A};$
 $R_i = 33 \text{ k}\Omega$

Typical bandwidth (3 dB); $R_S = 0$
Typical bandwidth (3 dB); $R_S = 50 \text{ k}\Omega$

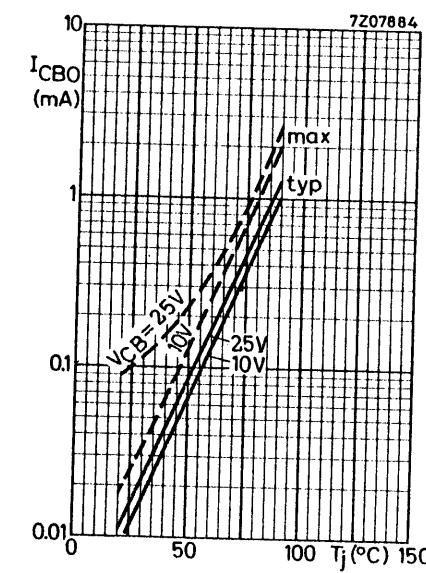
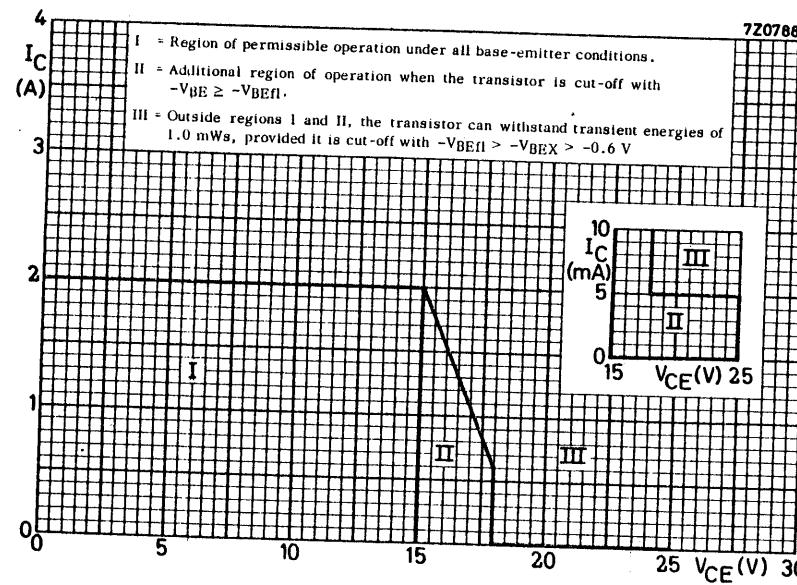
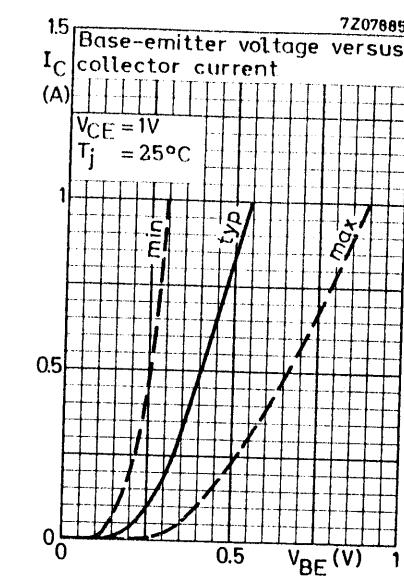
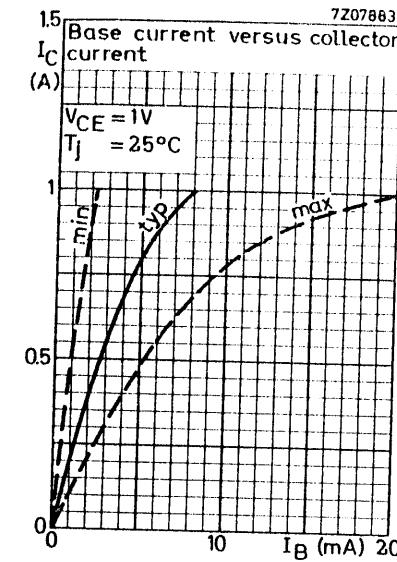
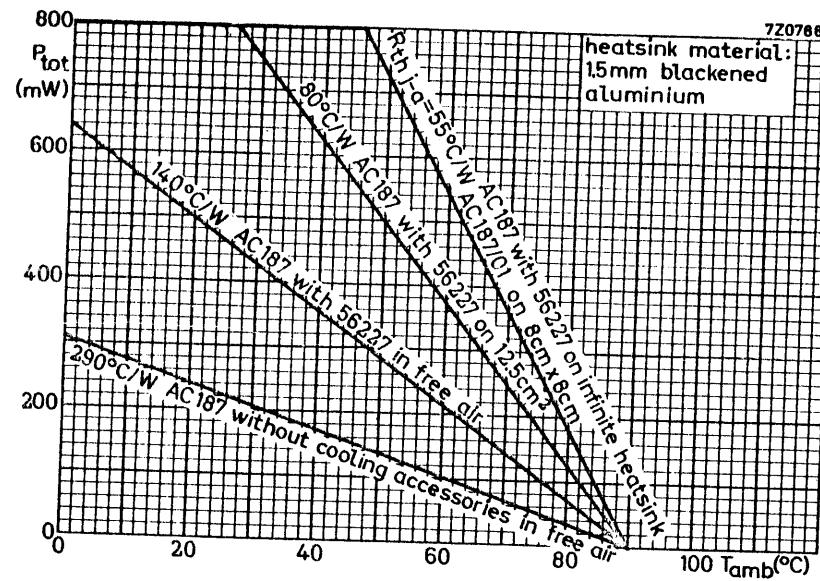
$B = 60 \text{ Hz to } 65 \text{ kHz}$
 $B = 65 \text{ Hz to } 35 \text{ kHz}$

Quiescent current

$|I_{cq}| = 5 \text{ mA, adjustable with } R_1$

When using AC187 and AC188 each transistor should be mounted with cooling clip 56227 on 1.5 mm blackened Al. heatsink of 3 cm x 3 cm.

When using AC187/01 and AC188/01 each transistor should be mounted on 1.5 mm blackened Al. heatsink of 2.5 cm x 2.5 cm.



GERMANIUM ALLOYED MEDIUM POWER TRANSISTORS

The AC188 is a p-n-p audio transistor in a TO-1 metal envelope. The AC188 is primarily intended for use together with the n-p-n medium power transistor AC187 as matched pair AC187/AC188 to about 3 W complementary symmetry class B output stages.

The AC188/01 is electrically equivalent to the AC188, constructed integrally with a heat conducting block, which gives better heat transfer. The thermal resistance from junction to heatsink shows an improvement ($\approx 10^{\circ}\text{C/W}$) as compared with that obtained with the AC188 when using heat conducting clip 56227.

The AC188/01 is also available as matched pair with the AC187/01.

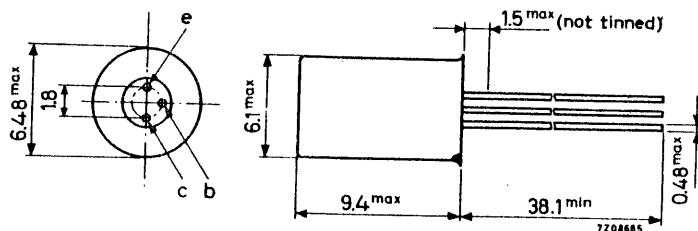
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{\text{CBO}}$	max.	25	V
Collector-emitter voltage (open base)	$-V_{\text{CEO}}$	max.	15	V
Collector current (peak value)	$-I_{\text{CM}}$	max.	2	A
Total power dissipation up to $T_{\text{amb}} = 46^{\circ}\text{C}$	P_{tot}	max.	0.8	W
Junction temperature	T_j	max.	90	$^{\circ}\text{C}$
D.C. current gain at $T_j = 25^{\circ}\text{C}$	$-I_C = 300 \text{ mA}; -V_{\text{CE}} = 1 \text{ V}$	h_{FE}	100 to 500	
Cut-off frequency				
$-I_C = 10 \text{ mA}; -V_{\text{CE}} = 2 \text{ V}$	f_{hfe}	typ.	10	kHz

MECHANICAL DATA

AC188

TO-1

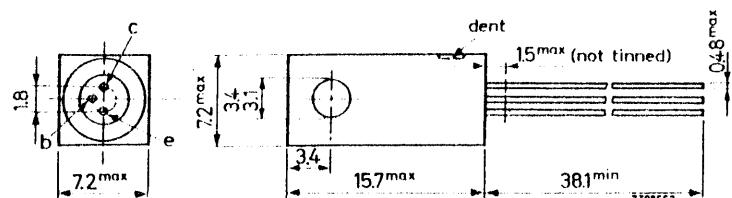


The coloured dot indicates the collector

Accessories available: 56200; 56208; 56209; 56210; 56226; 56227

MECHANICAL DATA (continued)

AC188/01



The dent indicates the collector

RATINGS (Limiting values)¹⁾

Voltages

Collector-base voltage (open emitter) $-V_{CBO}$ max. 25 V

Collector-emitter voltage (open base) $-V_{CEO}$ max. 15 V

Collector-emitter voltage
 $-I_C \leq 600 \text{ mA}; R_{BE} \leq 1 \Omega$ $-V_{CER}$ max. 18 V

Emitter-base voltage (open collector) $-V_{EBO}$ max. 10 V

Currents

Collector current (d.c. or average over
any 50 ms period) $-I_C$ max. 1 A

Collector current (peak value) $-I_{CM}$ max. 2 A

Power dissipation

Total power dissipation up to $T_{amb} = 46^\circ\text{C}$ ²⁾ P_{tot} max. 0.8 W

Temperatures

Storage temperature T_{stg} -55 to +75 $^\circ\text{C}$

Junction temperature T'_j max. 90 $^\circ\text{C}$

Dimensions in mm

THERMAL RESISTANCE

From junction to ambient in free air

without cooling clip

with cooling clip 56227

with cooling clip 56227 on

1.5 mm Al blackened heatsink of 12.5 cm^2

with cooling clip 56227 on infinite heatsink

AC188 | AC188/01

$R_{th j-a} = 290$ $^\circ\text{C/W}$

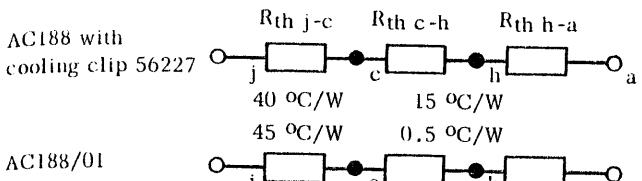
$R_{th j-a} = 140$ $^\circ\text{C/W}$

70.5 $^\circ\text{C/W}$

55 $^\circ\text{C/W}$

40 $^\circ\text{C/W}$

From junction to case



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

CHARACTERISTICS

Collector cut-off current

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

$-I_{CBO}$ typ. 20 μA

< 200 μA

$I_E = 0; -V_{CB} = 25 \text{ V}; T_j = 90^\circ\text{C}$

$-I_{CBO}$ < 1.4 mA

$+V_{BE} \approx 1.0 \text{ V}; -V_{CE} = 25 \text{ V}$

$-I_{CEX}$ < 200 μA

Emitter cut-off current

$I_C = 0; -V_{EB} = 10 \text{ V}$

$-I_{EBO}$ typ. 15 μA

< 200 μA

$I_C = 0; -V_{EB} = 10 \text{ V}; T_j = 90^\circ\text{C}$

$-I_{EBO}$ typ. 0.4 mA

< 1.4 mA

Base-emitter voltage

$-I_C = 5 \text{ mA}; -V_{CE} = 10 \text{ V}$

$-V_{BE}$ 115 to 145 mV

$-I_C = 300 \text{ mA}; -V_{CE} = 1 \text{ V}$

$-V_{BE}$ < 450 mV

Emitter-base floating voltage

$I_E = 0; -V_{CB} = 25 \text{ V}; T_j = 90^\circ\text{C}$

$-V_{EBfl}$ < 400 mV

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

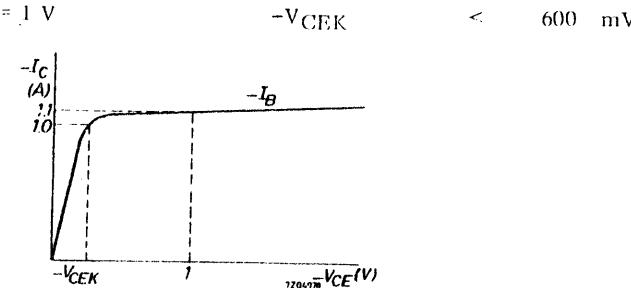
2) The allowable peak power in class B speech and musical driven amplifiers is 1.1 W

CHARACTERISTICS (continued)

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

Knee voltage

$-I_C = 1 \text{ A}$; $-I_B = \text{value for which}$
 $-I_C = 1.1 \text{ A at } -V_{CE} = 1 \text{ V}$



D.C. current gain

$-I_C = 5 \text{ mA}; -V_{CE} = 10 \text{ V}$

$h_{FE} > 70$

$-I_C = 300 \text{ mA}; -V_{CE} = 1 \text{ V}$

$h_{FE} \text{ typ. } 200$
100 to 500

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

$h_{FE} > 80$

Collector capacitance at $f = 450 \text{ kHz}$

$I_E = I_e = 0; -V_{CB} = 5 \text{ V}$

$C_C \text{ typ. } 90 \text{ pF}$
 $< 110 \text{ pF}$

Transition frequency

$-I_C = 10 \text{ mA}; -V_{CE} = 2 \text{ V}$

$f_T > 1 \text{ MHz}$
typ. 1.5 MHz

Cut-off frequency

$-I_C = 10 \text{ mA}; -V_{CE} = 2 \text{ V}$

$f_{hfe} \text{ typ. } 10 \text{ kHz}$

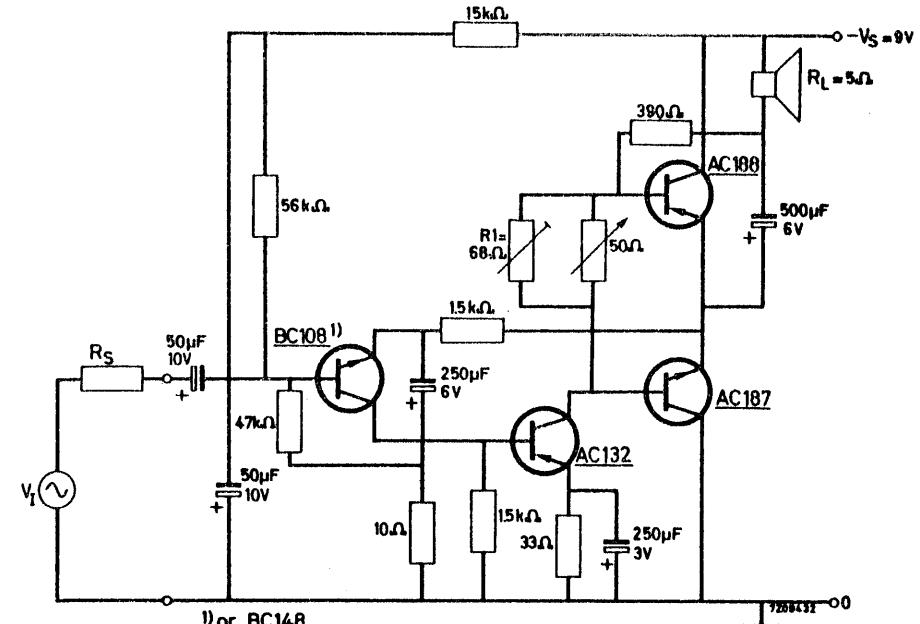
D.C. current gain ratio of matched pair AC187/AC188

$|I_C| = 500 \text{ mA}; |V_{CE}| = 1 \text{ V}$

$h_{FE1}/h_{FE2} < 1 : 1.25$

APPLICATION INFORMATION

1.5 W transformerless audio frequency amplifier with matched pair AC187/AC188 in complementary symmetry class B output stage up to $T_{amb} = 45^\circ\text{C}$



Typical input requirements
for an output power of 50 mW

$V_I(\text{rms}) = 4 \text{ mV}; I_I(\text{rms}) = 0.12 \mu\text{A};$
 $R_I = 33 \text{ k}\Omega$

Typical input requirements
for an output power of 1.5 W

$V_I(\text{rms}) = 22 \text{ mV}; I_I(\text{rms}) = 0.66 \mu\text{A};$
 $R_I = 33 \text{ k}\Omega$

Typical bandwidth (3 dB); $R_S = 0$

$B = 60 \text{ Hz to } 65 \text{ kHz}$

Typical bandwidth (3 dB); $R_S = 50 \text{ k}\Omega$

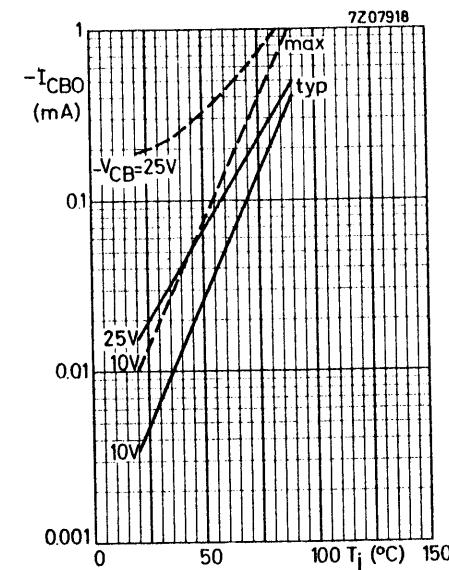
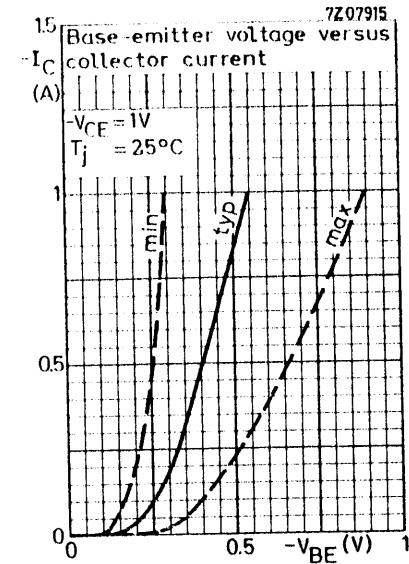
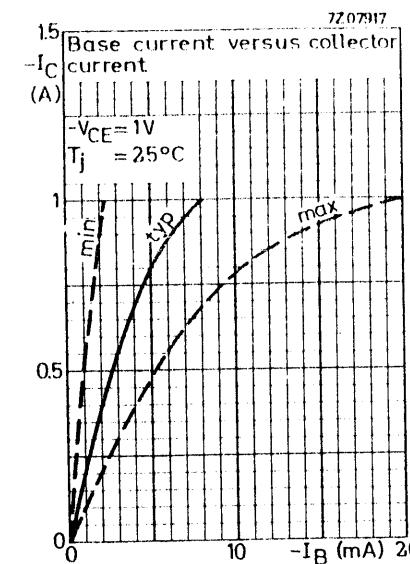
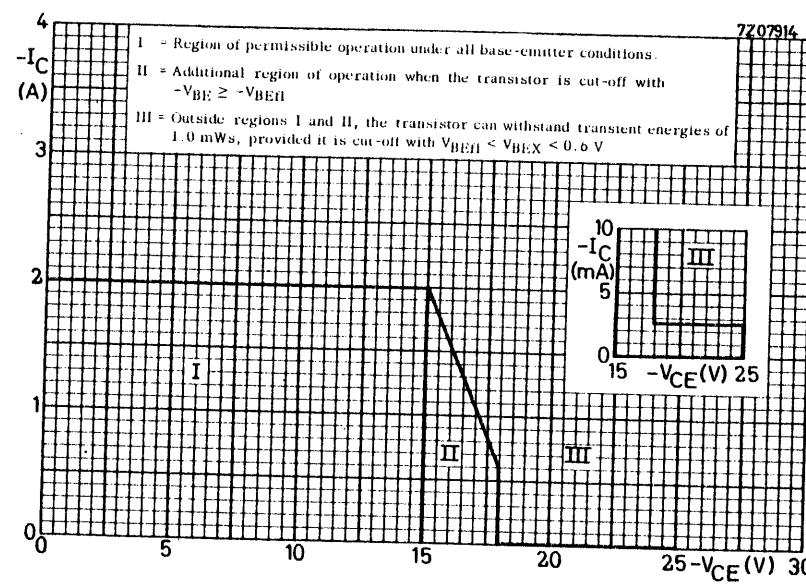
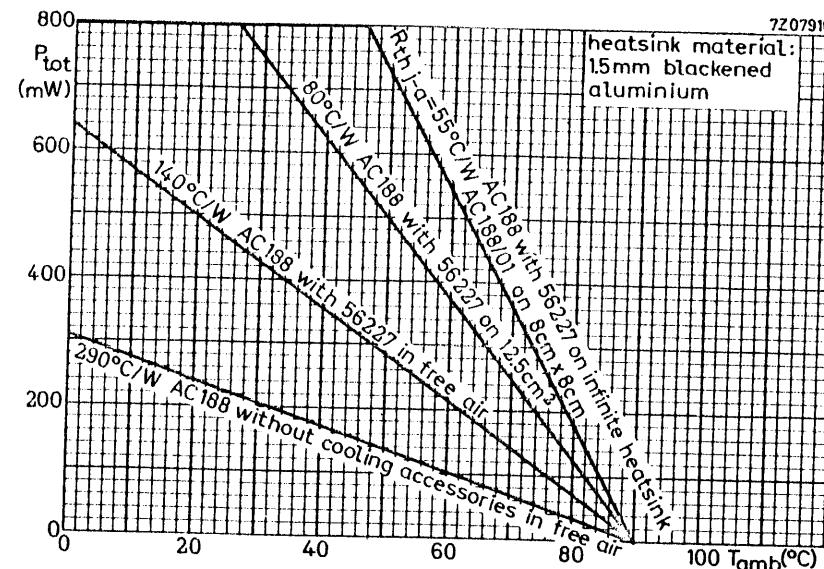
$B = 65 \text{ Hz to } 35 \text{ kHz}$

Quiescent current

$|I_{CQ}| = 5 \text{ mA, adjustable with } R_1$

When using AC187 and AC188 each transistor should be mounted with cooling clip 56227 on 1.5 mm blackened Al. heatsink of 3 cm x 3 cm.

When using AC187/01 and AC188/01 each transistor should be mounted on 1.5 mm blackened Al. heatsink of 2.5 cm x 2.5 cm.



GERMANIUM ALLOYED POWER TRANSISTORS

P-N-P power transistor in a metal envelope with the collector connected to the mounting base.

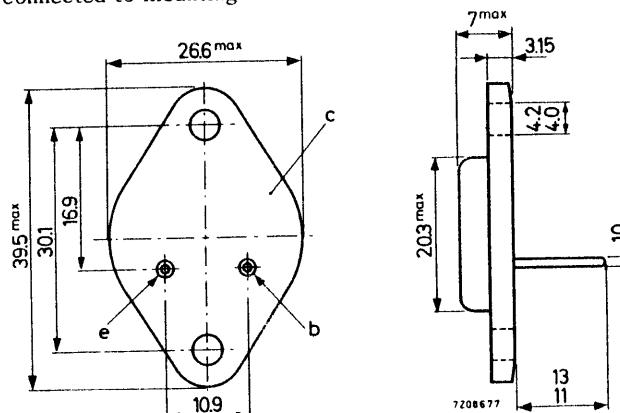
It is primarily intended for use as matched pair 2-AD149 in class B push-pull output stages with an output power of up to 20 W.

QUICK REFERENCE DATA			
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30 V
Collector current (d.c.)	$-I_C$	max.	3.5 A
Total power dissipation up to $T_{mb} = 45^\circ\text{C}$	P_{tot}	max.	32.5 W
Junction temperature (incidentally)	T_j	max.	110 $^\circ\text{C}$
D.C. current gain at $T_j = 25^\circ\text{C}$			
$-I_C = 1 \text{ A}; -V_{CB} = 0 \text{ V}$	h_{FE}	30 to 100	
Cut-off frequency			
$-I_C = 0.5 \text{ A}; -V_{CE} = 2 \text{ V}$	f_{hfe}	typ.	10 kHz

MECHANICAL DATA

Collector connected to mounting base

Dimensions in mm



Accessories available: 56201

RATINGS (Limiting values)¹⁾Voltages

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	50	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	30	V
Collector-emitter voltage with $R_{BE} < 175 \Omega$	$-V_{CER}$	max.	50	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	20	V

Currents

Collector current (d.c.)	$-I_C$	max.	3.5	A
Base current (d.c.)	$-I_B$	max.	0.5	A

Power dissipation

Total power dissipation up to $T_{mb} = 45^\circ\text{C}$	P_{tot}	max.	32.5	W
---	-----------	------	------	---

Temperatures

Storage temperature	T_{stg}	-65 to +100	$^\circ\text{C}$
Junction temperature: continuous	T_j	max.	100 $^\circ\text{C}$
incidentally	T_j	max.	110 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to mounting base	$R_{th j-mb}$	=	2	$^\circ\text{C}/\text{W}$
From mounting base to heatsink with mica washer and insulating bush without insulating materials and with lead washer	$R_{th mb-h}$	=	0.5	$^\circ\text{C}/\text{W}$
	$R_{th mb-h}$	=	0.2	$^\circ\text{C}/\text{W}$

CHARACTERISTICS $T_j = 25^\circ\text{C}$ unless otherwise specifiedCollector cut-off current

$I_E = 0$; $-V_{CB} = 50$ V	$-I_{CBO}$	<	3	mA
$I_E = 0$; $-V_{CB} = 14$ V; $T_j = 90^\circ\text{C}$	$-I_{CBO}$	<	5	mA

Emitter cut-off current

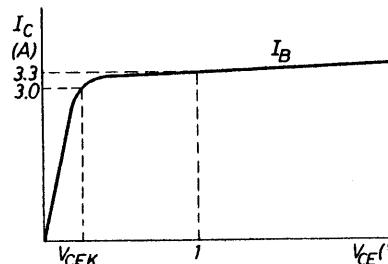
$I_C = 0$; $-V_{EB} = 20$ V	$-I_{EBO}$	<	3	mA
------------------------------	------------	---	---	----

Base-emitter voltage

$-I_C = 15$ mA; $-V_{CE} = 14$ V	$-V_{BE}$	135 to 175	mV
$-I_C = 200$ mA; $-V_{CE} = 1$ V	$-V_{BE}$	<	300 mV
$-I_C = 3.5$ A; $-V_{CE} = 1$ V	$-V_{BE}$	<	1200 mV

Knee voltage

$-I_C = 3$ A; $-I_B$ = value for which			
$-I_C = 3.3$ A at $-V_{CE} = 1$ V	$-V_{CEK}$	<	0.7 V

D.C. current gain

$-I_C = 1$ A; $V_{CB} = 0$	h_{FE}	30 to 100
$-I_C = 3$ A; $V_{CB} = 0$	h_{FE}	20 to 85

Collector capacitance at $f = 450$ kHz

$I_E = I_e = 0$; $-V_{CB} = 5$ V	C_c	typ.	220	pF
-----------------------------------	-------	------	-----	----

Emitter capacitance at $f = 450$ kHz

$I_C = I_e = 0$; $-V_{EB} = 5$ V	C_e	typ.	140	pF
-----------------------------------	-------	------	-----	----

¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS (continued) $T_j = 25^\circ\text{C}$ unless otherwise specifiedTransition frequency $-I_C = 0.5 \text{ A}; -V_{CE} = 2 \text{ V}$ f_T typ. > 300 kHz
typ. 500 kHzCut-off frequency $-I_C = 0.5 \text{ A}; -V_{CE} = 2 \text{ V}$ f_{hfe} typ. > 7 kHz
typ. 10 kHzFeedback impedance at $f = 450 \text{ kHz}$ $I_E = 1 \text{ mA}; -V_{CB} = 5 \text{ V}$ $|z_{rb}|$ typ. 30 Ω Small signal current gain linearity¹⁾

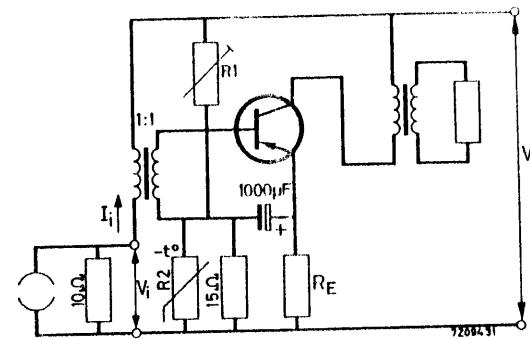
(See page 10)

 λ_{3A} typ. > 0.2
typ. 0.35D.C. current gain ratio of

matched pair 2-AD149

 $-I_C = 0.3 \text{ A}$ h_{FE1}/h_{FE2} typ. 1.1 $-I_C = 3 \text{ A}$ h_{FE1}/h_{FE2} typ. 1.1
< 1.25**APPLICATION INFORMATION**

AD149 in a class A output amplifier.



Stable continuous operation is ensured at an ambient temperature up to 55°C provided each transistor is mounted on a 1.5 mm copper heatsink of at least 18 cm x 18 cm (circuit I) or 15 cm x 15 cm (circuit II).

Characteristics

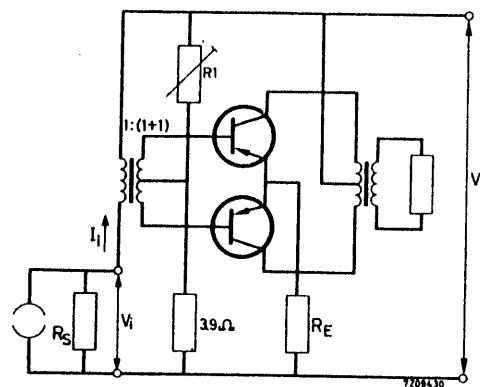
		I	II
Supply voltage	V_S	= 7 < 8	14 V 16 V
Collector current (zero signal)	$-I_C$	= 1.8	0.72 A
Bias resistor	R_1	= 50	200 Ω
NTC resistor ¹⁾	R_2	= 50	50 Ω
Emitter resistor	R_E	= 0.3	0.5 Ω
Collector resistance	$R_{C\sim}$	= 4	23 Ω
Total power dissipation of the transistor	P_{tot}	< 4.3	4.1 W
Output power delivered to transformer	P_O	< 4	4 W
Input voltage (peak value) at $P_O = 4 \text{ W}$	V_{IM}	typ. 0.48	0.40 V
Input current (peak value) at $P_O = 4 \text{ W}$	I_{IM}	typ. 35	12 mA
Total distortion at $P_O = 4 \text{ W}$	d_{tot}	typ. 9.5	7.5 %
Input current (peak value) at $P_O = 50 \text{ mW}$	I_{IM}	typ. 2.5	1.0 mA
Total distortion at $P_O = 50 \text{ mW}$	d_{tot}	typ. 2.5	1.5 %

1) NTC resistor should be mounted on the heatsink, close to the transistor.
Code number 2322 610 11509.

$\lambda_{3A} = \frac{A_i \text{ at } -I_C = 3 \text{ A}}{A_{i\max}}$

APPLICATION INFORMATION

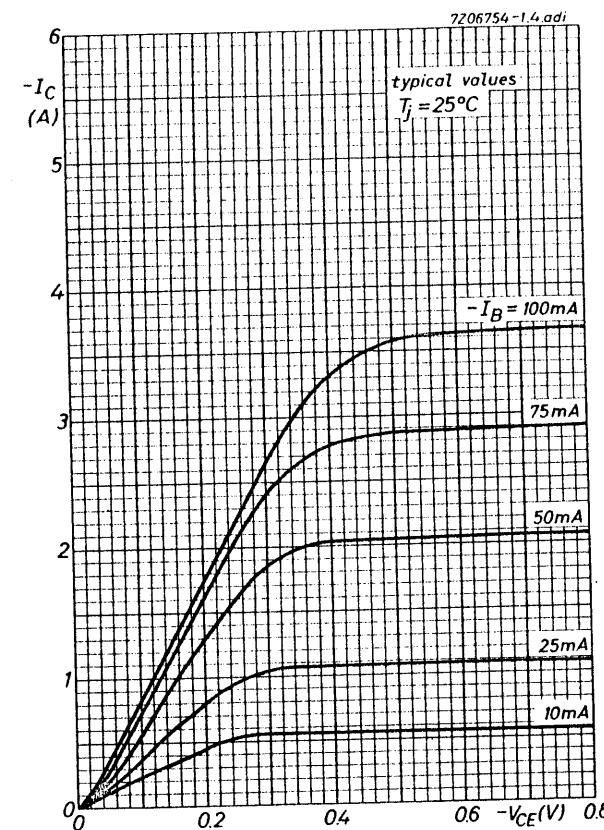
2-AD149 in a class B output amplifier.

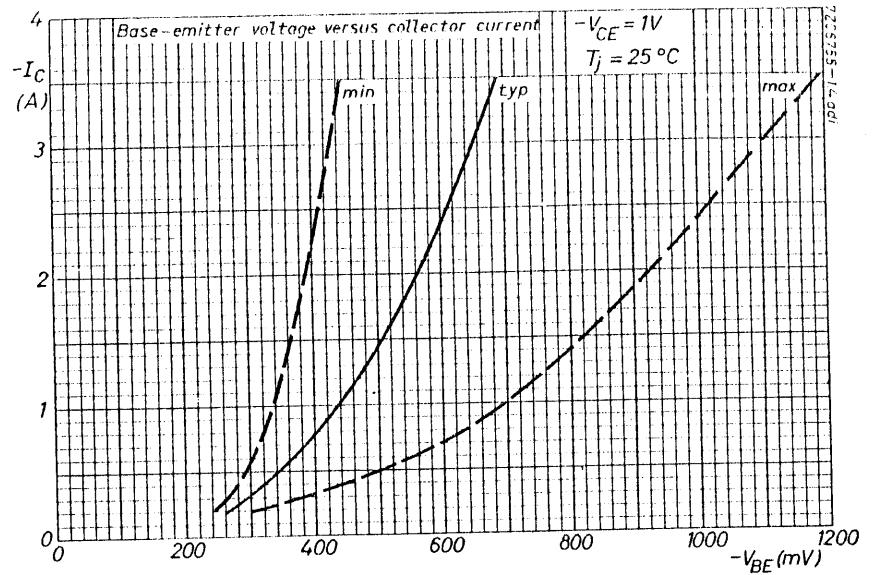
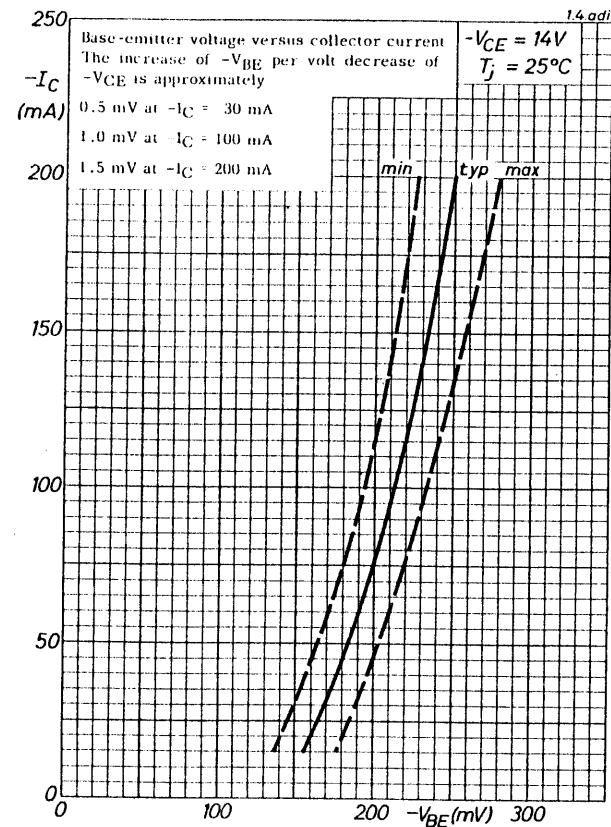


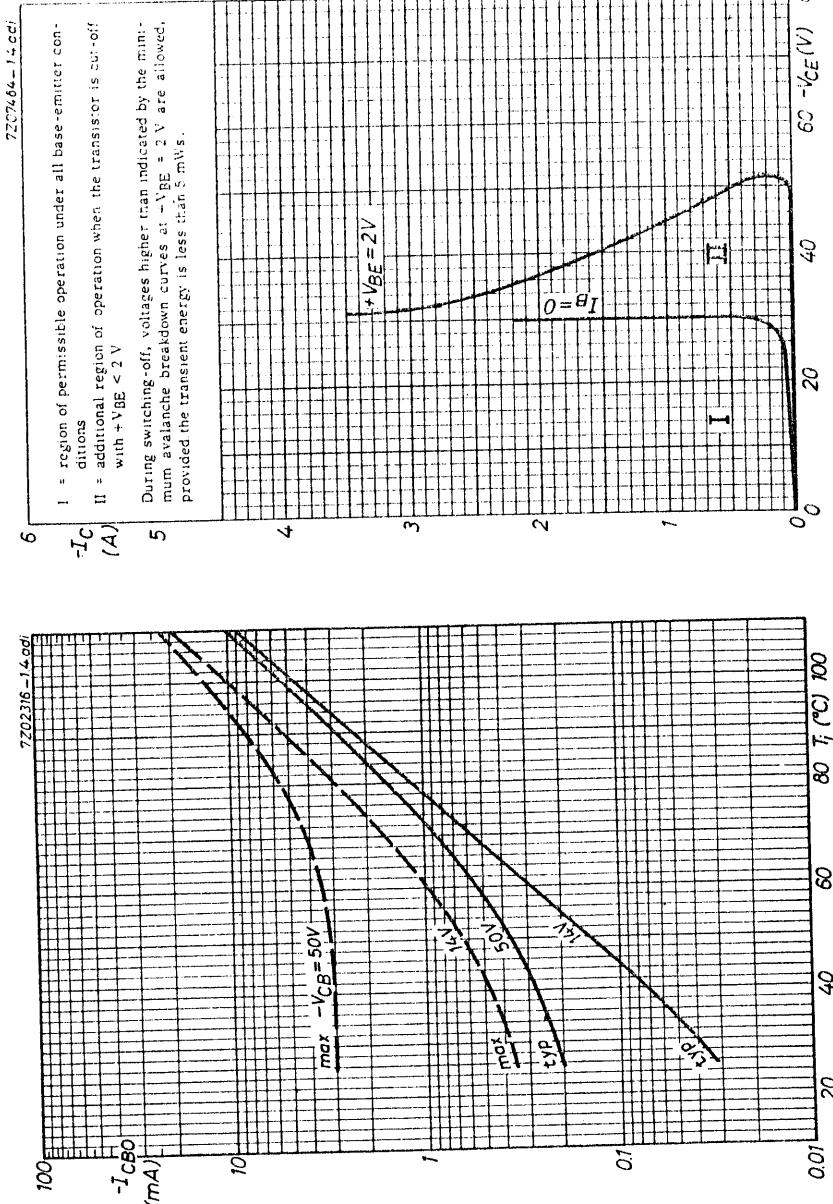
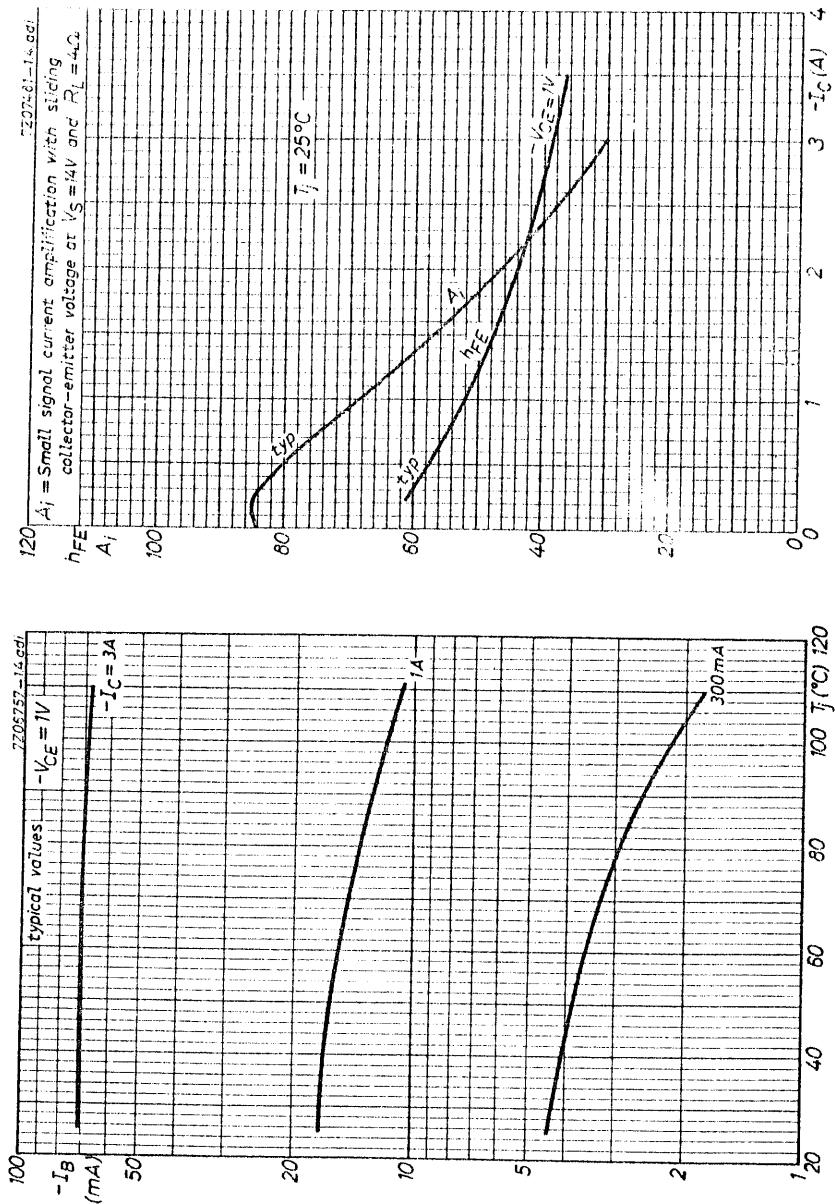
Stable continuous operation is ensured at an ambient temperature up to 55 °C provided each transistor is mounted on a 1.5 mm copper heatsink of at least 5 cm x 5 cm (circuit I) or 6 cm x 6 cm (circuit II).

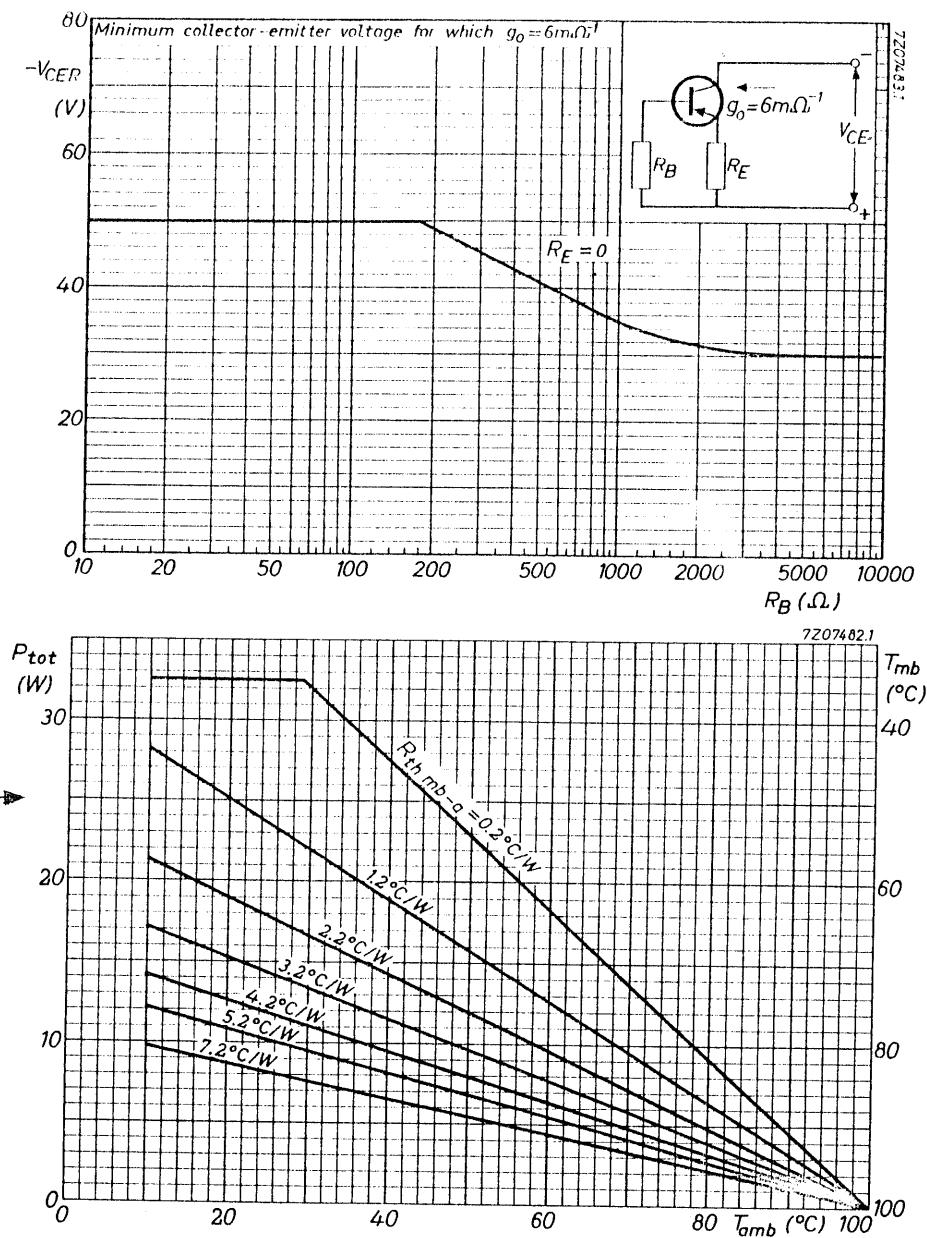
Characteristics

		I	II
Supply voltage	V _S	= 7 < 8	14 V 16 V
Collector current (zero signal)	-I _C	= 60	60 mA
Bias resistor	R ₁	= 200	350 Ω
Emitter resistor	R _E	= 0	0.47 Ω
Source resistance	R _S	= 450	370 Ω
Collector resistance	R _{CC~}	= 9	16 Ω
Total power dissipation of the transistors	P _{tot}	< 9.75	20 W
Output power delivered to transformer	P _O	< 9.75	17.9 W
Collector current (peak value) at P _O max	-I _{CM}	typ. 3	3 A
Collector current at P _O max	-I _C	typ. 0.95	0.95 A
Input voltage (peak value) at P _O max	V _{IM}	typ. 0.81	2.2 V
Input current (peak value) at P _O max	I _{IM}	typ. 75	75 mA
Total distortion at P _O max	d _{tot}	typ. 10	10 %
Input current (peak value) at P _O = 50 mW	I _{IM}	typ. 4	2.5 mA
Total distortion at P _O = 50 mW	d _{tot}	typ. 2.5	2 %









GERMANIUM ALLOYED POWER TRANSISTOR

N-P-N power transistor in a metal envelope with the collector connected to the mounting base.

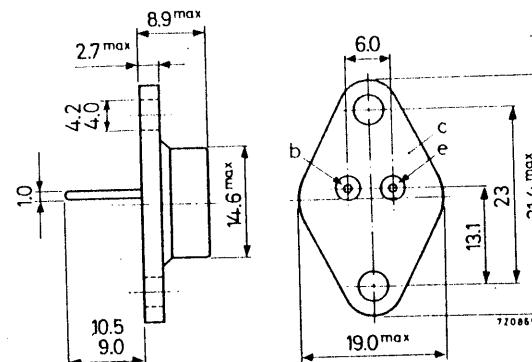
The AD161 is primarily intended for use together with the p-n-p power transistor AD162 as matched pair AD161/AD162 in 10 W complementary symmetry class B output stages of mains operated amplifiers and radio receivers.

QUICK REFERENCE DATA		
Collector-base voltage (open emitter)	V_{CBO}	max. 32 V
Collector-emitter voltage (open base)	V_{CEO}	max. 20 V
Collector current (peak value)	I_{CM}	max. 3 A
Total power dissipation up to $T_{mb} = 75^{\circ}\text{C}$	P_{tot}	max. 4 W
Junction temperature (incidentally)	T_j	max. 100 $^{\circ}\text{C}$
D.C. current gain at $T_j = 25^{\circ}\text{C}$	$I_C = 0.5 \text{ A}; V_{CE} = 1 \text{ V}$	
Cut-off frequency	$I_C = 0.3 \text{ A}; V_{CE} = 2 \text{ V}$	
	f_{hfe}	typ. 35 kHz

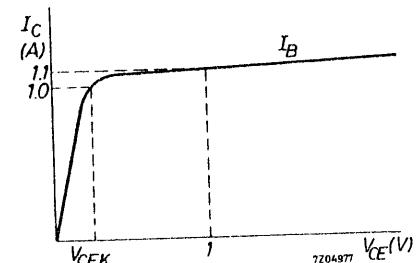
MECHANICAL DATA

Collector connected to mounting base

Dimensions in mm



Accessories available: 56203

RATINGS (Limiting values) ¹⁾VoltagesCollector-base voltage (open emitter) V_{CBO} max. 32 VCollector-emitter voltage (open base) V_{CEO} max. 20 VCollector-emitter voltage with $-V_{BE} = 0.6$ V
(See also page 4) V_{CEX} max. 32 VEmitter-base voltage (open collector) V_{EBO} max. 10 VCurrentsCollector current (d.c. or average over any 50 ms period) I_C max. 1 ACollector current (peak value) I_{CM} max. 3 APower dissipationTotal power dissipation up to $T_{mb} = 72$ °C P_{tot} max. 4 WTemperaturesStorage temperature T_{stg} -65 to +90 °CJunction temperature: continuous
incidentally T_j max. 90 °C
 T_j max. 100 °C**THERMAL RESISTANCE**From junction to mounting base $R_{th\ j-mb}$ = 4.5 °C/WFrom mounting base to heatsink
with mica washer $R_{th\ mb-h}$ = 1.5 °C/Wwithout mica washer $R_{th\ mb-h}$ = 0.5 °C/W**CHARACTERISTICS** $T_j = 25$ °C unless otherwise specifiedCollector cut-off current $I_E = 0; V_{CB} = 32$ V I_{CBO} typ. 20 μ A
 $I_E < 500$ μ A $I_E = 0; V_{CB} = 32$ V; $T_j = 90$ °C I_{CBO} < 3 mA $-V_{BE} = 0.6$ V; $V_{CE} = 32$ V; $T_j = 90$ °C I_{CEX} < 3 mA**CHARACTERISTICS (continued)**Emitter cut-off current $I_C = 0; V_{EB} = 10$ V $T_j = 25$ °C unless otherwise specified I_{EBO} typ. < 200 μ A $I_C = 0; V_{EB} = 10$ V; $T_j = 90$ °C I_{EBO} < 2 mABase-emitter voltage ¹⁾ $I_C = 5$ mA; $V_{CE} = 10$ V V_{BE} 110 to 140 mV $I_C = 50$ mA; $V_{CE} = 1$ V V_{BE} < 300 mV $I_C = 500$ mA; $V_{CE} = 1$ V V_{BE} < 650 mV $I_C = 2$ A; $V_{CE} = 1$ V V_{BE} < 1100 mVKnee voltage $I_C = 1$ A; I_B = value for which $I_C = 1.1$ A at $V_{CE} = 1$ V V_{CEK} < 600 mVFloating voltage $I_E = 0; V_{CB} = 32$ V; $T_j = 90$ °C V_{EBfl} < 400 mVCollector capacitance at $f = 450$ kHz $I_E = I_e = 0; V_{CB} = 5$ V C_c typ. 150 pFD.C. current gain $I_C = 5$ mA; $V_{CE} = 10$ V h_{FE} > 55 $I_C = 50$ mA; $V_{CE} = 1$ V h_{FE} 74 to 300 $I_C = 500$ mA; $V_{CE} = 1$ V h_{FE} typ. 150
80 to 320 $I_C = 2$ A; $V_{CE} = 1$ V h_{FE} > 40¹⁾ V_{BE} decreases by about 2 mV/°C with increasing temperature.¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS (continued)

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

Transition frequency

 $I_C = 10 \text{ mA}; V_{CE} = 2 \text{ V}$ f_T typ. 3 MHz

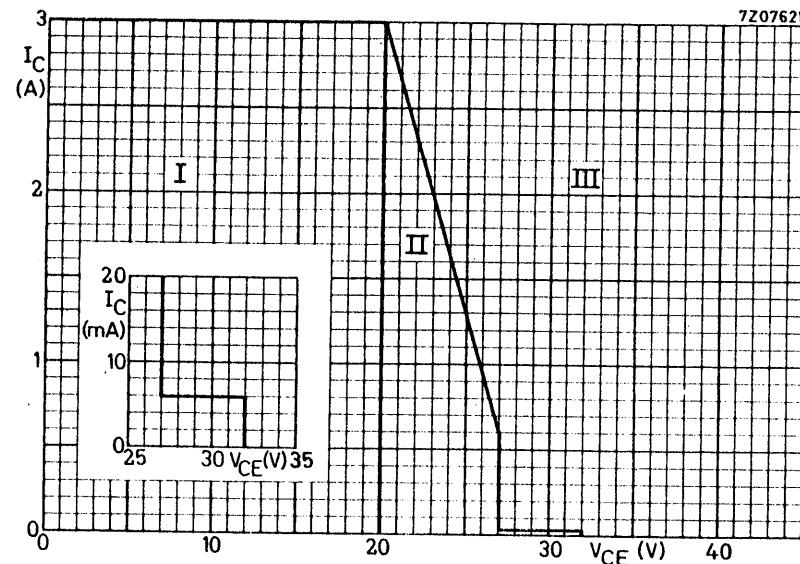
Cut-off frequency

 $I_C = 300 \text{ mA}; V_{CE} = 2 \text{ V}$ f_{hfe} typ. > 20 kHz

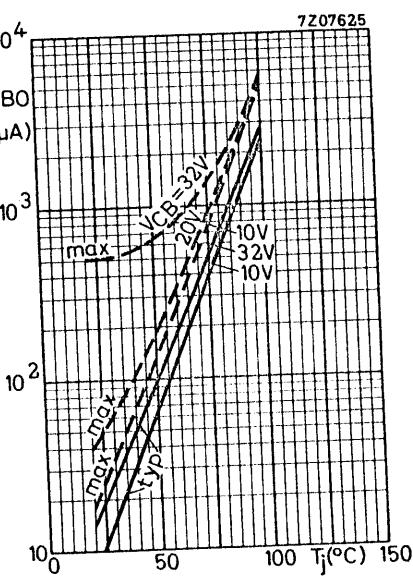
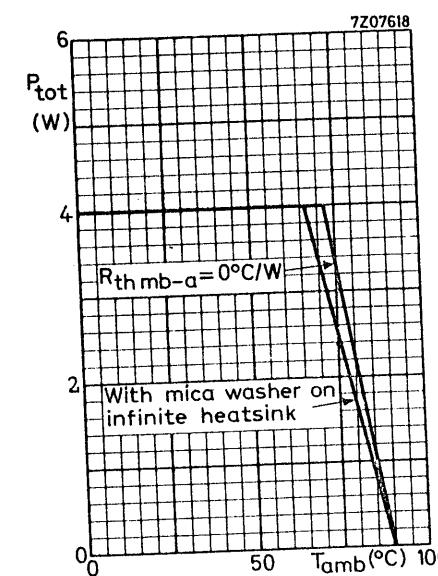
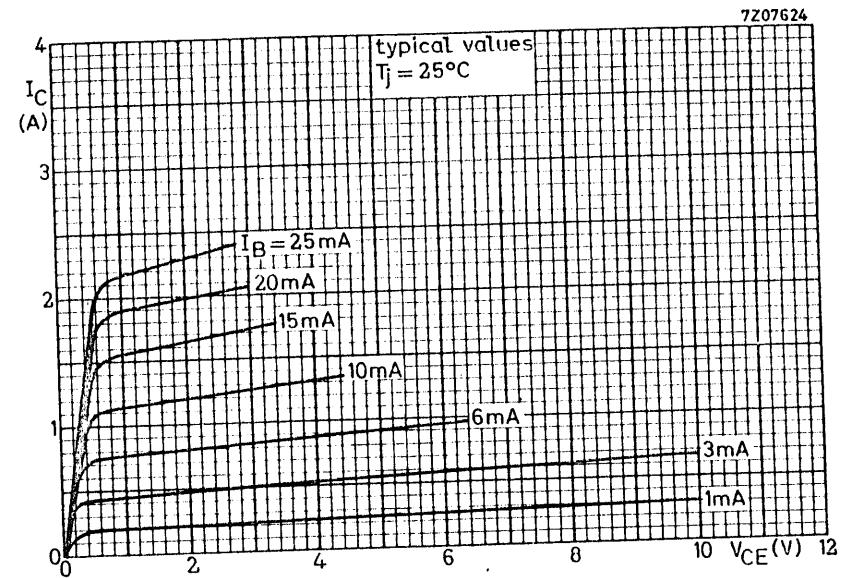
typ. 35 kHz

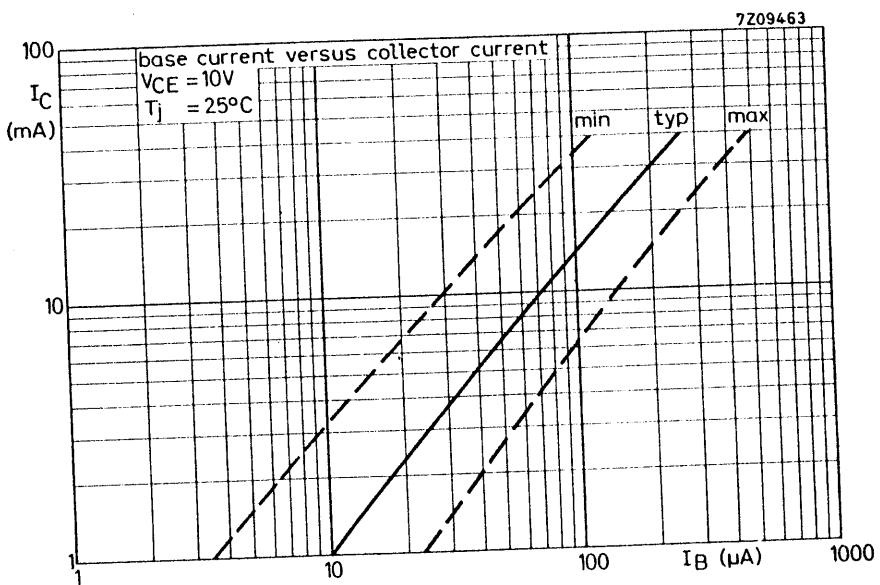
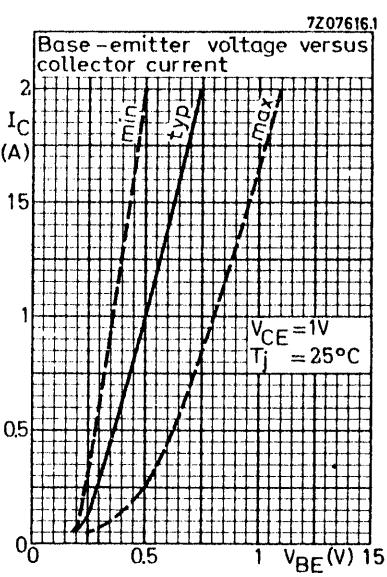
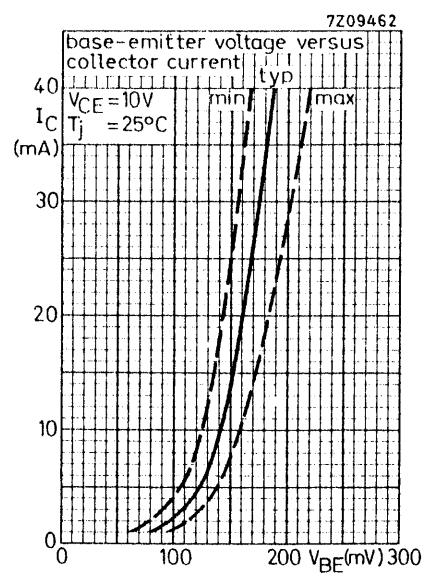
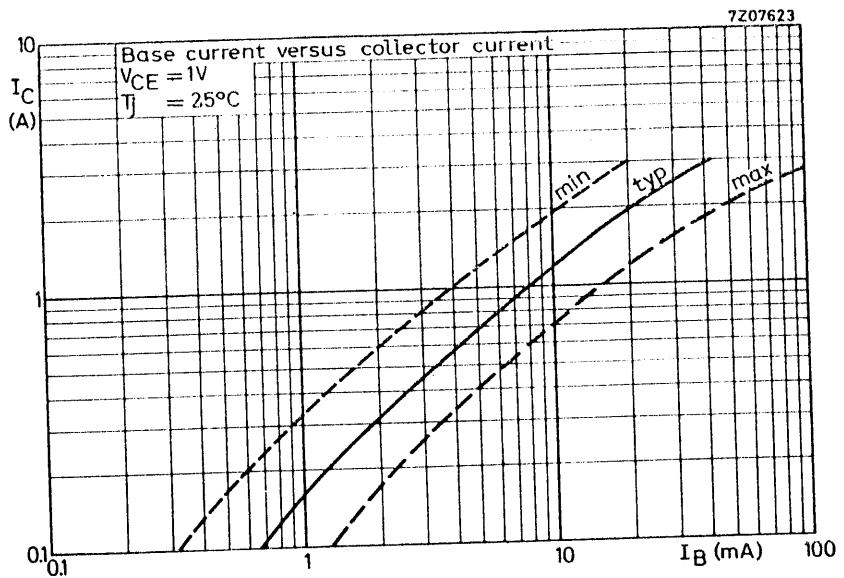
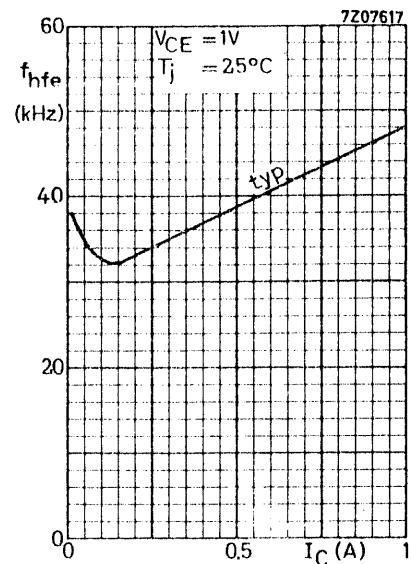
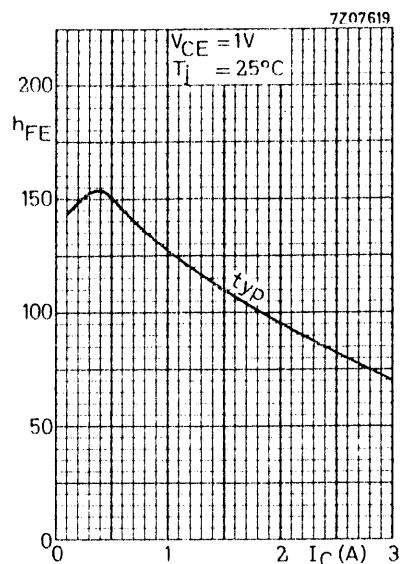
D.C. current gain ratio

of matched pair AD161/AD162

 $|I_C| = 500 \text{ mA}; |V_{CE}| = 1 \text{ V}$ h_{FE1}/h_{FE2} typ. 1.1
< 1.25

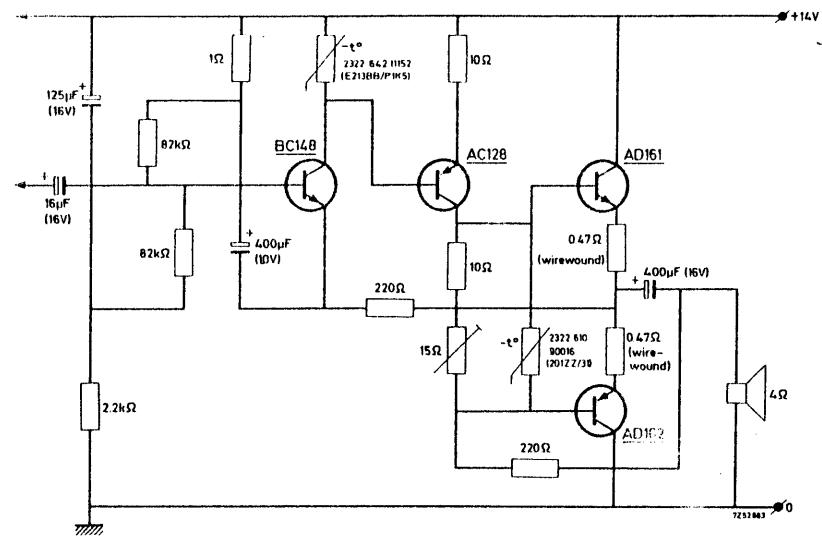
I = Region of permissible operation under all base-emitter conditions.

II = Additional region of operation when the transistor is cut-off with $-V_{BE} \geq -V_{BEfl}$.III = Outside regions I and II, the transistor can withstand transient energies of 1 mWs, provided it is cut-off with $-V_{BB} \leq 0.6 \text{ V}$; $R_i = 18 \Omega$.



APPLICATION INFORMATION

A. 4 W car radio amplifier for 12 V



All transistors mounted on one heatsink which has a thermal resistance of $R_{th\ h-a} \leq 5.5\ ^\circ C/W$

Performance at $T_{amb} = 25\ ^\circ C$

Output power at $d_{tot} = 10\%$

$$P_o = 4 \text{ W}$$

Sensitivity at $P_o = 50 \text{ mW}$

$$V_i = 5 \text{ mV}$$

$$P_o = 4 \text{ W}$$

$$V_i = 48 \text{ mV}$$

Input impedance

$$Z_i = 10 \text{ k}\Omega$$

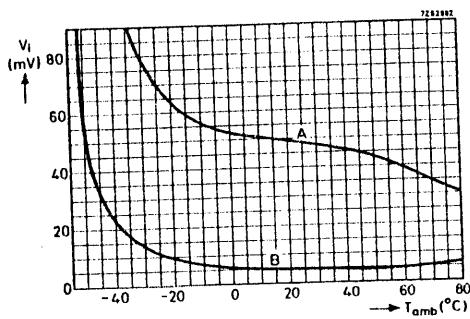
Frequency response (-3 dB)

$$200 \text{ Hz to } 20 \text{ kHz}$$

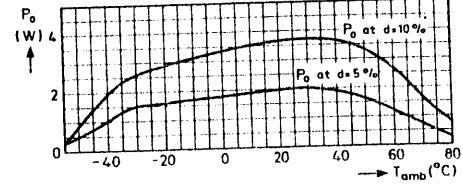
Operating ambient temperature

$$T_{amb} = 20 \text{ to } 70 \text{ }^\circ C$$

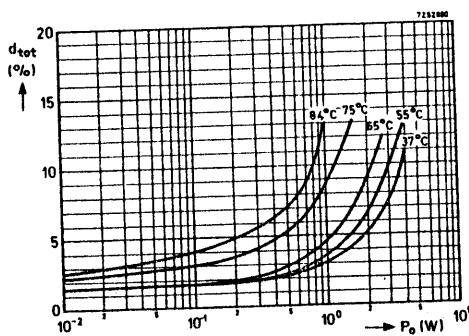
APPLICATION INFORMATION (continued)



Input sensitivity at various ambient temperatures. Curve A for maximum output power at a distortion of 10%. Curve B for an output power of 50 mW.



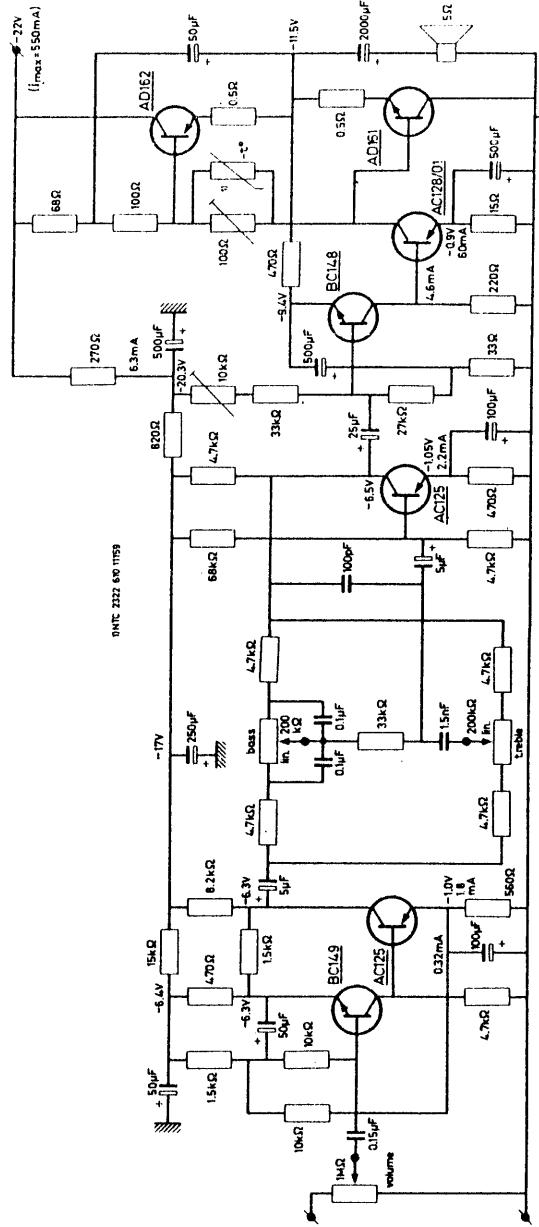
The output power at two distortion levels as a function of the ambient temperature.



The distortion as a function of the output power at several ambient temperatures.

APPLICATION INFORMATION (continued)

B. 8 W amplifier with matched pair AD161/AD162



This amplifier can safely be employed up to an ambient temperature of 45°C, provided the transistors AD161 and AD162 are mounted on a common heatsink of 200 cm², thickness 2 mm and the AC128/01 on a heatsink of 50 cm².

APPLICATION INFORMATION (continued)

Performance

Output power at onset of clipping

$$P_o = 8 \text{ W}$$

$$d_{dot} = 0.6\%; f = 1 \text{ kHz}$$

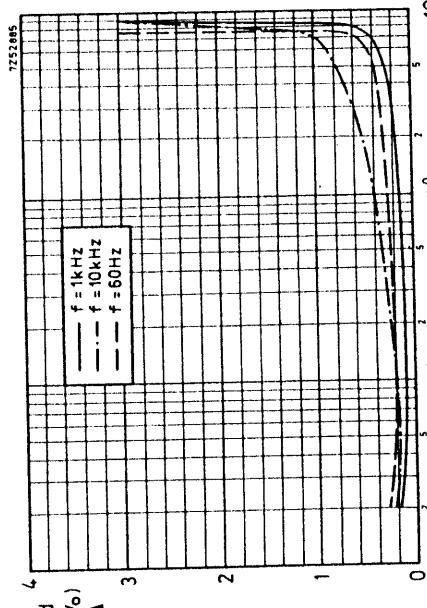
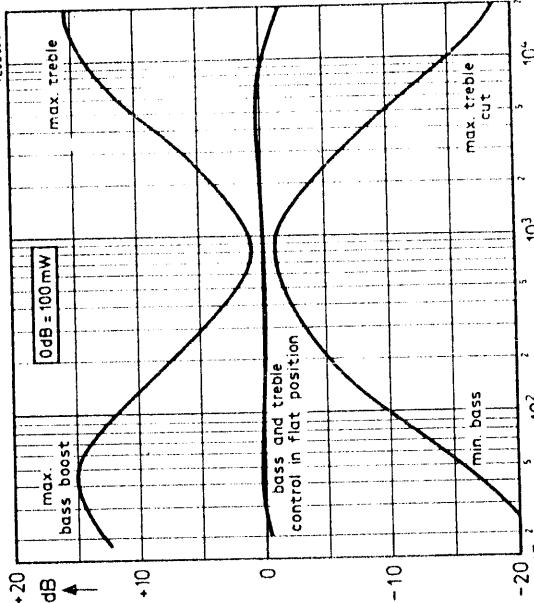
Sensitivity at $P_o = 50 \text{ mW}$

$$V_i = 8.7 \text{ mV}$$

$$V_i = 110 \text{ mV}$$

$$Z_i = 500 \text{ k}\Omega$$

Signal-noise ratio at $P_o = 8.7 \text{ W}$ power supply unstabilized stabilized	$S/N = 56 \text{ dB}$ $S/N = 70 \text{ dB}$
Frequency response (-3 dB)	20 Hz to 20 kHz
Bass control at 45 Hz	-16.5 to +15 dB
Treble control at 20 kHz	-18 to +15.5 dB



The distortion as function of the output power at three different frequencies.

Control facilities of the 8 W amplifier.

GERMANIUM ALLOYED POWER TRANSISTOR

P-N-P power transistor in a metal envelope with the collector connected to the mounting base.

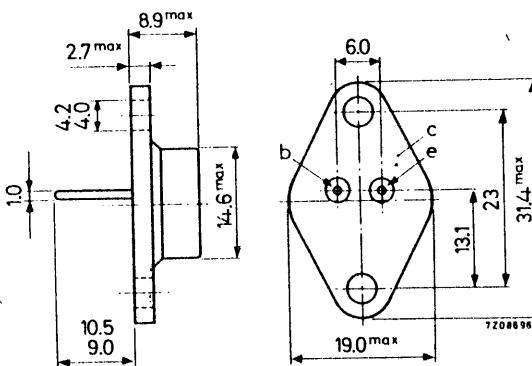
It is primarily intended for use as matched pair 2-AD162 in class B push-pull output stages and together with the n-p-n power transistor AD161 as matched pair AD161/AD162 in 10 W complementary symmetry class B output stages of mains operated amplifiers and radio receivers.

QUICK REFERENCE DATA			
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	32 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	20 V
Collector current (peak value)	$-I_{CM}$	max.	3 A
Total power dissipation up to $T_{mb} = 63^\circ\text{C}$	P_{tot}	max.	6 W
Junction temperature (incidentally)	T_j	max.	100 $^\circ\text{C}$
D.C. current gain at $T_j = 25^\circ\text{C}$			
$-I_C = 0.5 \text{ A}; -V_{CE} = 1 \text{ V}$	h_{FE}	80 to 320	
Cut-off frequency			
$-I_C = 0.3 \text{ A}; -V_{CE} = 2 \text{ V}$	f_{hfe}	typ.	15 kHz

MECHANICAL DATA

Collector connected to mounting base

Dimensions in mm



Accessories available: 56203

RATINGS (Limiting values)¹⁾

Voltages

Collector-base voltage (open emitter)	-V _{CBO}	max.	32 V
Collector-emitter voltage (open base)	-V _{CEO}	max.	20 V
Collector-emitter voltage with +V _{BE} = 0.6 V (See also page 4)	-V _{CEX}	max.	32 V
Emitter-base voltage (open collector)	-V _{EBO}	max.	10 V

Currents

Collector current (d.c. or average over any 50 ms period)	-I _C	max.	1 A
Collector current (peak value)	-I _{CM}	max.	3 A

Power dissipation

Total power dissipation up to T _{mb} = 63 °C	P _{tot}	max.	6 W
---	------------------	------	-----

Temperatures

Storage temperature	T _{stg}	-65 to +90 °C
Junction temperature: continuous	T _j	max. 90 °C
incidentally	T _j	max. 100 °C

THERMAL RESISTANCE

From junction to mounting base	R _{th j-mb}	=	4.5 °C/W
From mounting base to heatsink with mica washer	R _{th mb-h}	=	1.5 °C/W
without mica washer	R _{th mb-h}	=	0.5 °C/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current

I _E = 0; -V _{CB} = 32 V	-I _{CBO}	typ.	15 μA
I _E = 0; -V _{CB} = 32 V; T _j = 90 °C + V _{BE} = 0.6 V; -V _{CE} = 32 V; T _j = 90 °C	-I _{CBO}	<	2 mA
+ V _{BE} = 0.6 V; -V _{CE} = 32 V; T _j = 90 °C	-I _{CEX}	<	2 mA

Emitter cut-off current

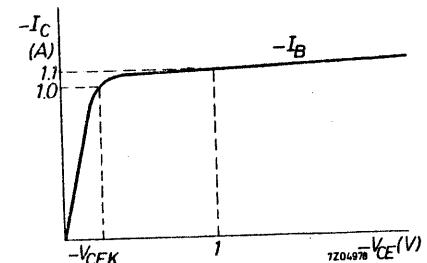
I _C = 0; -V _{EB} = 10 V	-I _{EBO}	typ.	15 μA
I _C = 0; -V _{EB} = 10 V; T _j = 90 °C	-I _{EBO}	<	2 mA

Base-emitter voltage¹⁾

-I _C = 5 mA; -V _{CE} = 10 V	-V _{BE}	115 to 145 mV
-I _C = 50 mA; -V _{CE} = 1 V	-V _{BE}	< 300 mV
-I _C = 500 mA; -V _{CE} = 1 V	-V _{BE}	< 550 mV
-I _C = 2 A; -V _{CE} = 1 V	-V _{BE}	< 850 mV

Knee voltage

-I _C = 1 A; -I _B = value for which -I _C = 1.1 A at -V _{CE} = 1 V	-V _{CEK}	< 400 mV
---	-------------------	----------



Floating voltage

I _E = 0; -V _{CB} = 32 V; T _j = 90 °C	-V _{EBfl}	< 400 mV
---	--------------------	----------

Collector capacitance at f = 450 kHz

I _E = I _e = 0; -V _{CB} = 5 V	C _c	typ. 115 pF
---	----------------	-------------

¹⁾ -V_{BE} decreases by about 2 mV/°C with increasing temperature.

¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS (continued)

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

D.C. current gain

$-I_C = 5 \text{ mA}; -V_{CE} = 10 \text{ V}$	h_{FE}	> 60
$-I_C = 50 \text{ mA}; -V_{CE} = 1 \text{ V}$	h_{FE}	74 to 300
$-I_C = 500 \text{ mA}; -V_{CE} = 1 \text{ V}$	h_{FE}	typ. 150
$-I_C = 2 \text{ A}; -V_{CE} = 1 \text{ V}$	h_{FE}	80 to 320

Transition frequency

$-I_C = 10 \text{ mA}; -V_{CE} = 2 \text{ V}$	f_T	typ. 1.5 MHz
---	-------	--------------

Cut-off frequency

$-I_C = 300 \text{ mA}; -V_{CE} = 2 \text{ V}$	f_{hfe}	typ. 15 kHz
--	-----------	-------------

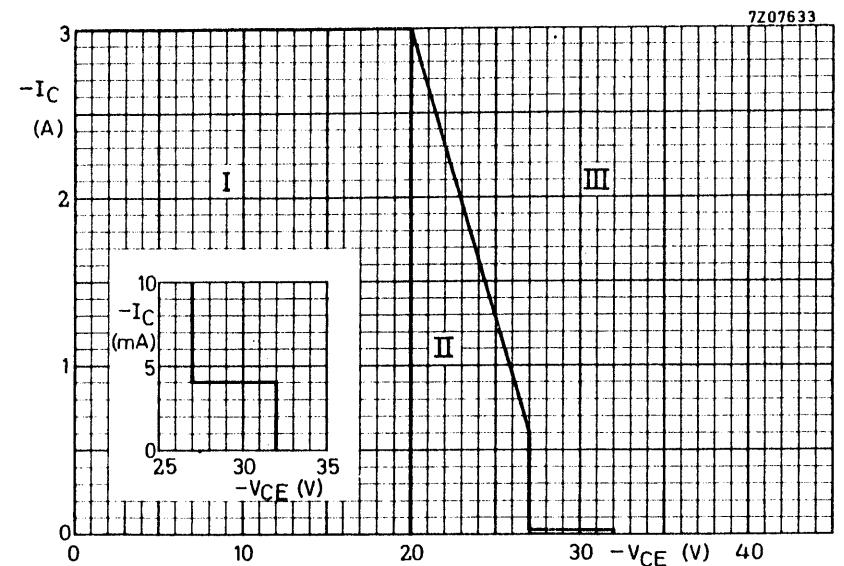
D.C. current gain ratio of matched pair AD161/AD162

$ I_C = 500 \text{ mA}; V_{CE} = 1 \text{ V}$	h_{FE1}/h_{FE2}	typ. 1.1
--	-------------------	----------

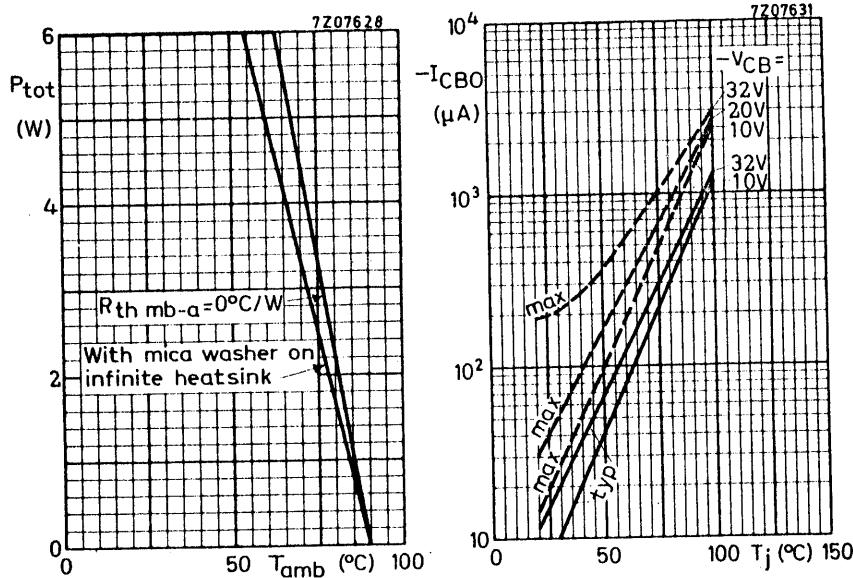
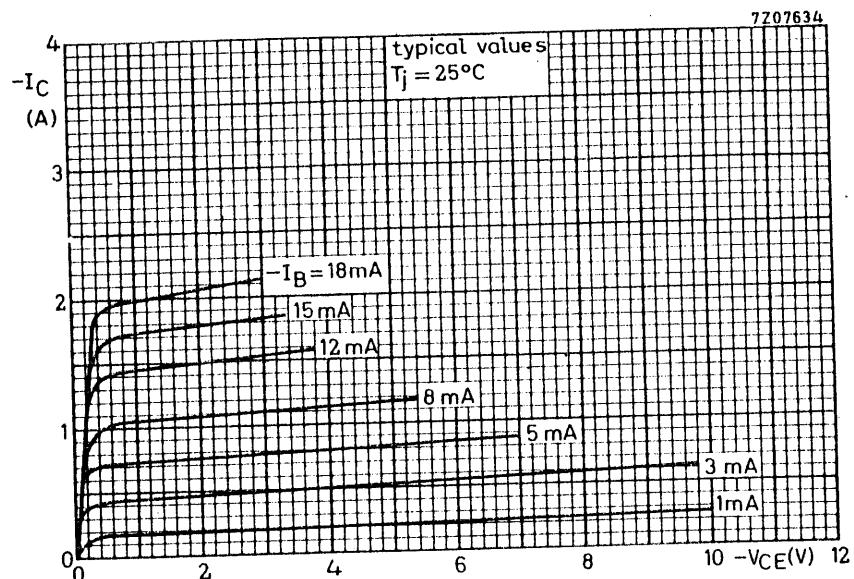
matched pair 2-AD162

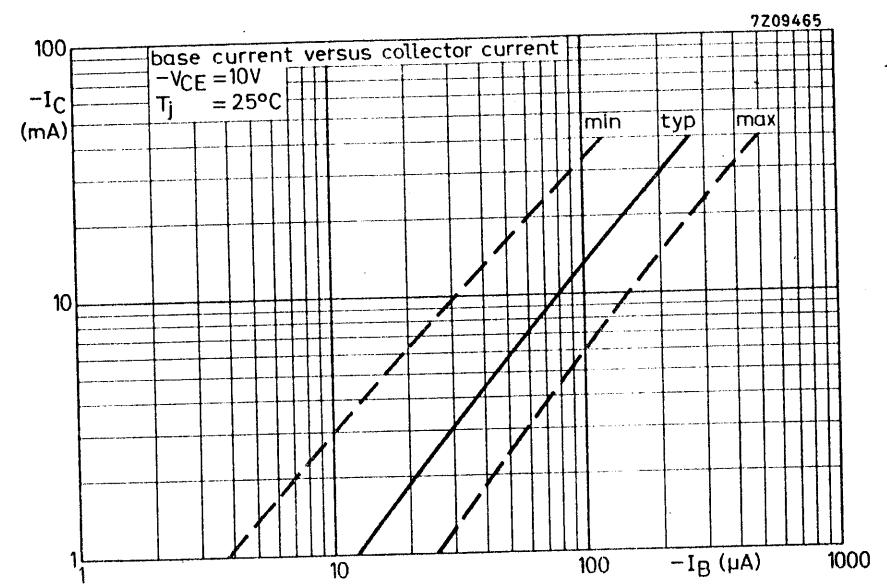
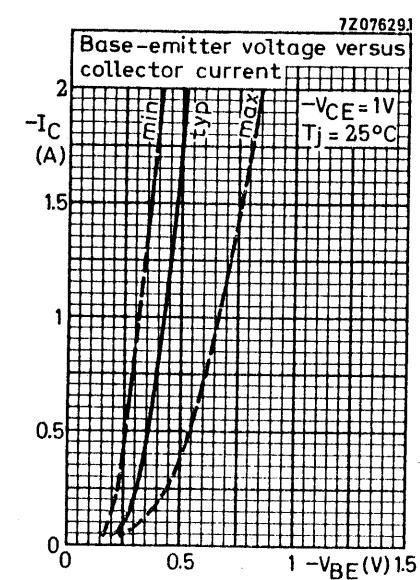
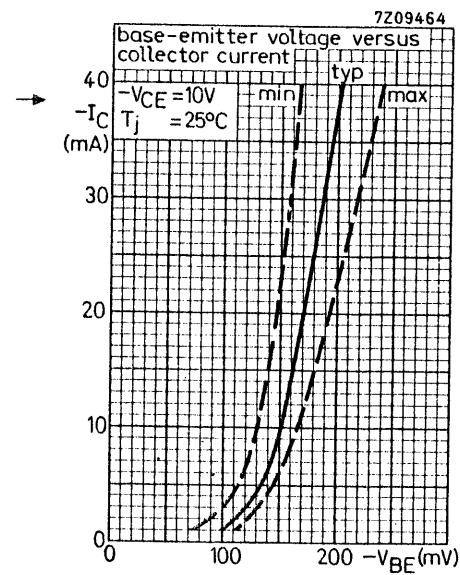
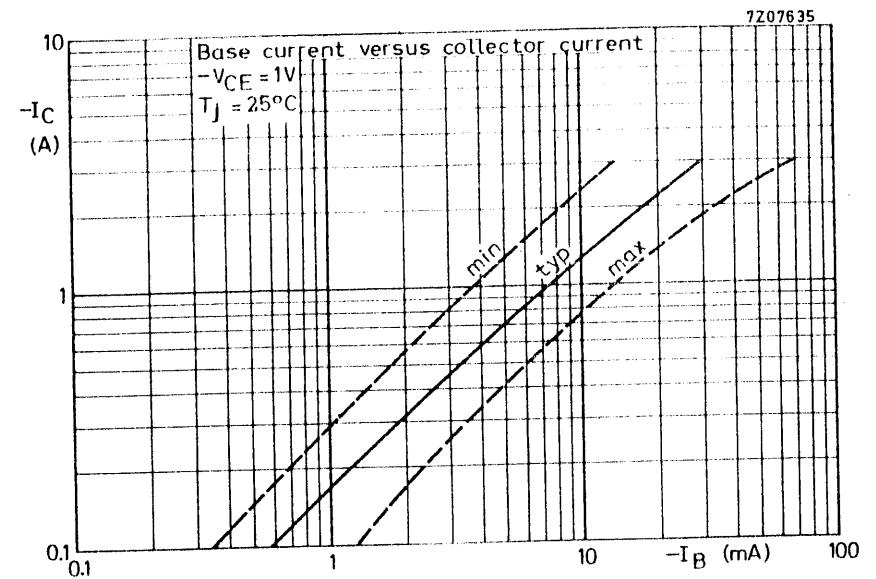
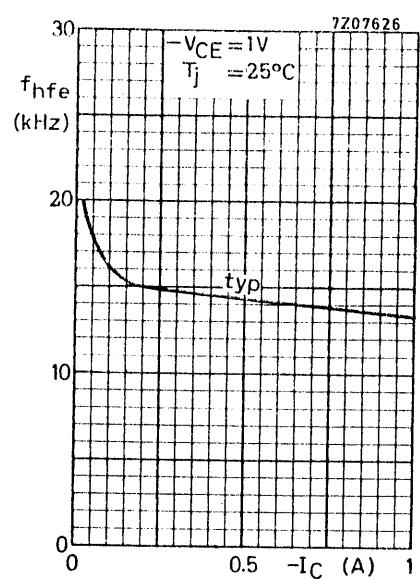
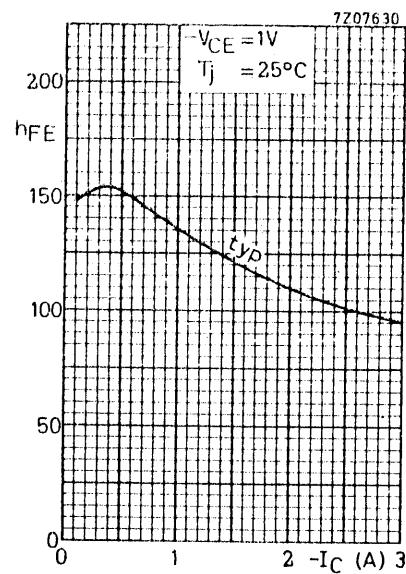
$-I_C = 50 \text{ mA}; -V_{CE} = 1 \text{ V}$	h_{FE1}/h_{FE2}	typ. 1.1
---	-------------------	----------

$-I_C = 500 \text{ mA}; -V_{CE} = 1 \text{ V}$	h_{FE1}/h_{FE2}	< 1.25
--	-------------------	----------

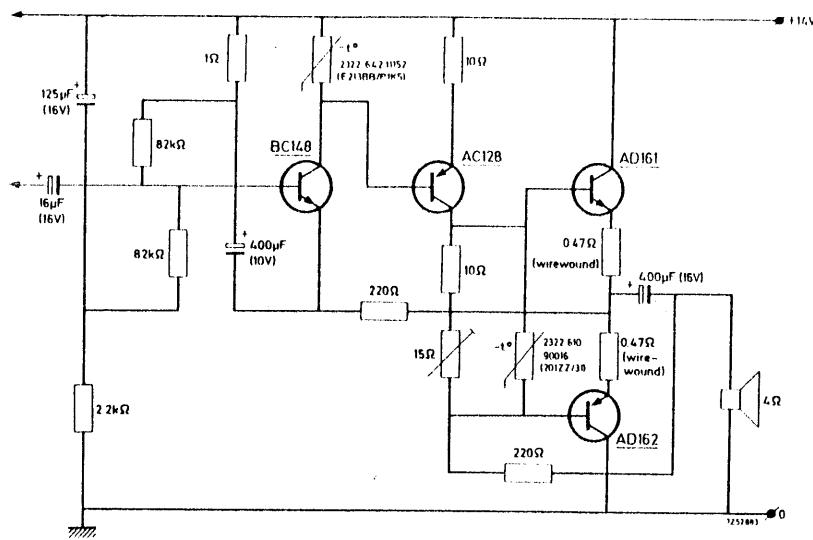


- I Region of permissible operation under all base-emitter conditions.
 II Additional region of operation when the transistor is cut-off with $V_{BE} \geq V_{BEfl}$.
 III Outside regions I and II, the transistor can withstand transient energies of 4.5 mWs, provided it is cut-off with $+V_{BB} < 0.6 \text{ V}$; $R_i = 18 \Omega$.





APPLICATION INFORMATION

A. 4 W car radio amplifier for 12 V

All transistors mounted on one heatsink which has a thermal resistance of $R_{th\ h-a} \leq 5.5\ ^\circ\text{C}/\text{W}$

Performance at $T_{amb} = 25^\circ\text{C}$

Output power at $d_{tot} = 10\%$

$$P_o = 4 \text{ W}$$

Sensitivity at $P_o = 50 \text{ mW}$

$$V_i = 5 \text{ mV}$$

$$P_o = 4 \text{ W}$$

$$V_i = 48 \text{ mV}$$

Input impedance

$$Z_i = 10 \text{ k}\Omega$$

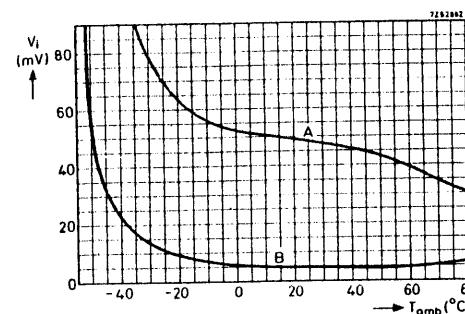
Frequency response (-3 dB)

$$200 \text{ Hz to } 20 \text{ kHz}$$

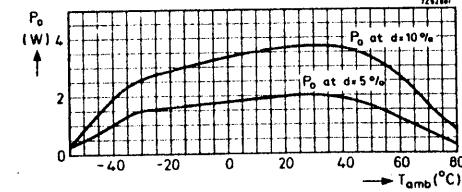
Operating ambient temperature

$$T_{amb} = 20 \text{ to } 70^\circ\text{C}$$

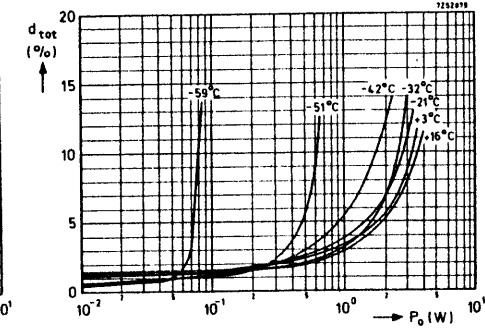
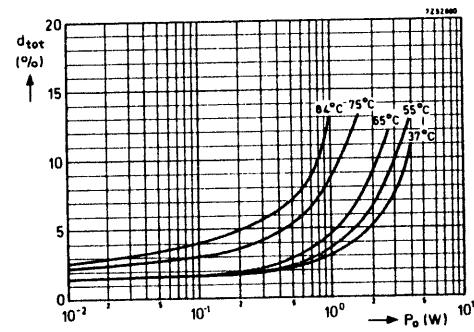
APPLICATION INFORMATION (continued)



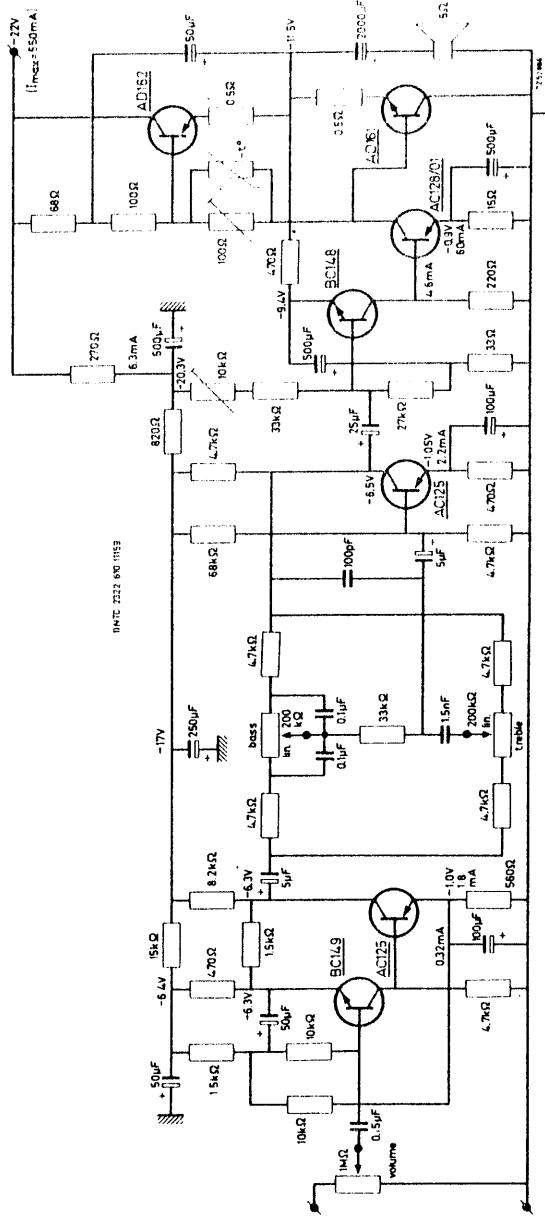
Input sensitivity at various ambient temperatures. Curve A for maximum output power at a distortion of 10%. Curve B for an output power of 50 mW.



The output power at two distortion levels as a function of the ambient temperature.



The distortion as a function of the output power at several ambient temperatures.



This amplifier can safely be employed up to an ambient temperature of 45°C, provided the transistors AD161 and AD162 are mounted on a common heatsink of 200 cm², thickness 2 mm and the AC128/01 on a heatsink of 50 cm².

APPLICATION INFORMATION (continued)

Performance

Output power at onset of clipping
 $d_{\text{tot}} = 0.6\%$; $f = 1 \text{ kHz}$

Sensitivity at $P_0 = 50 \text{ mW}$
 $P_0 = 8.7 \text{ W}$

Input impedance

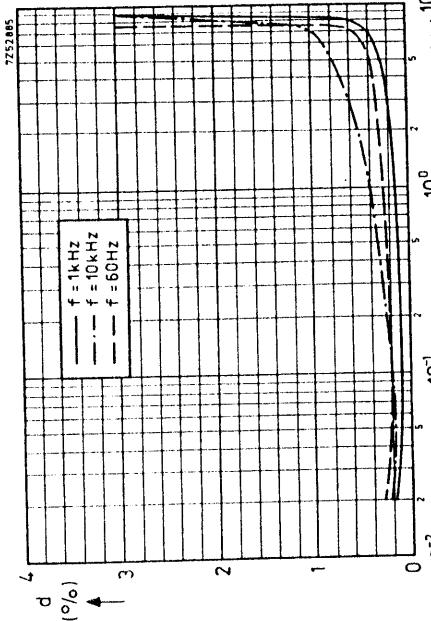
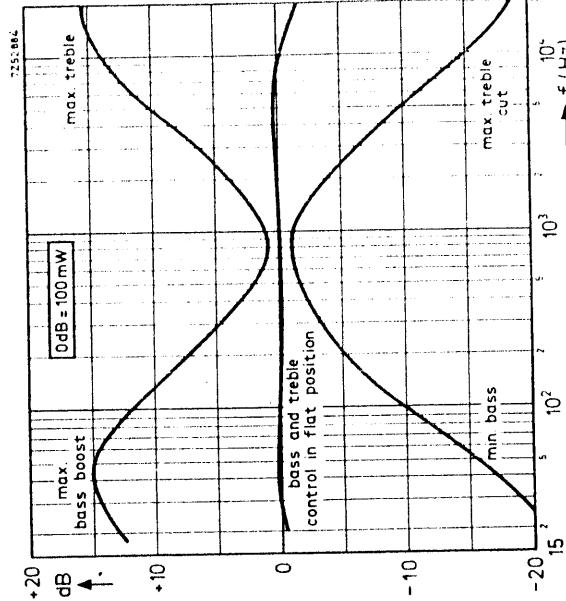
Signal-noise ratio at $P_0 = 8.7 \text{ W}$
 power supply unstabilized

stabilized

S/N = 56 dB
 S/N = 70 dB
 Frequency response (-3 dB)
 $20 \text{ Hz to } 20 \text{ kHz}$

Bass control at 45 Hz
 $-16.5 \text{ to } +15 \text{ dB}$

Treble control at 20 kHz
 $-16 \text{ to } +15.5 \text{ dB}$



The distortion as function of the output power at three different frequencies.

AUDIO FREQUENCY PACKAGE

The package 40809 comprises 4 transistors, intended for application in audio frequency d.c.-coupled amplifiers with complementary output stages with power outputs up to 1200 mW.

The matched pair AC127/AC128 (NPN/PNP, marked 3) consists of two transistors with high values of the d.c. amplification factor hFE .

The AC128 (PNP, marked 2) should be used in the drive stage.

The AC127 (NPN, marked 1) is meant for use in the pre-amplifier stage.

APPLICATIONS

On the following pages four circuits are described in detail

QUICK REFERENCE DATA					
Circuit	I	II	III	IV	
Supply voltage Vs	6	6	9	9	V
Maximum output power ($d_{tot} = 10\%$) P_o max	350	700	650	1200	mW
Required input voltage ($P_o = 50$ mW) ¹⁾					
without feedback $V_i(rms)$	1.8	2.1	1.0	1.2	mV
with 6 dB feedback $V_i(rms)$	3.5	5.0	2.5	2.0	mV

FOR DATA OF THE INDIVIDUAL TRANSISTORS
REFER TO THE DATA SHEETS OF THE AC127 AND THE AC128

1) Spread of input sensitivity < 3 dB

TYPICAL OPERATION CHARACTERISTICS ($f = 1$ kHz)

Circuit	I	II	III	IV
Supply voltage V_S	6	6	9	9 V
Max. output power at $d_{tot} \approx 10\%$ P_o max	350	700	650	1200 mW
Input voltage at $P_o = 50$ mW without feedback $V_i(\text{rms})$	1.8	2.1	1.0	1.2 mV
with 6 dB feedback $V_i(\text{rms})$	3.5	5.0	2.5	2.0 mV
Input voltage at $P_o = \text{max.}$ without feedback $V_i(\text{rms})$	5.3	8.6	4.6	5.6 mV
with 6 dB feedback $V_i(\text{rms})$	10.7	20.7	10.4	10.2 mV
Zero signal collector currents ¹⁾ of transistors 3 $ I_C $	4	5	3	5 mA
Collector peak current at P_o max I_{CM}	260	500	300	470 mA
Collector current of the driver transistor 2 $-I_C$	4.6	8.3	5.4	7.7 mA
Midtap voltage at B V	3.3	3.6	4.9	4.9 V
Typical input resistance at A without feedback R_i	3.8	6.0	3.3	2.8 kΩ
with 6 dB feedback R_i	7.3	11.5	6.4	4.3 kΩ

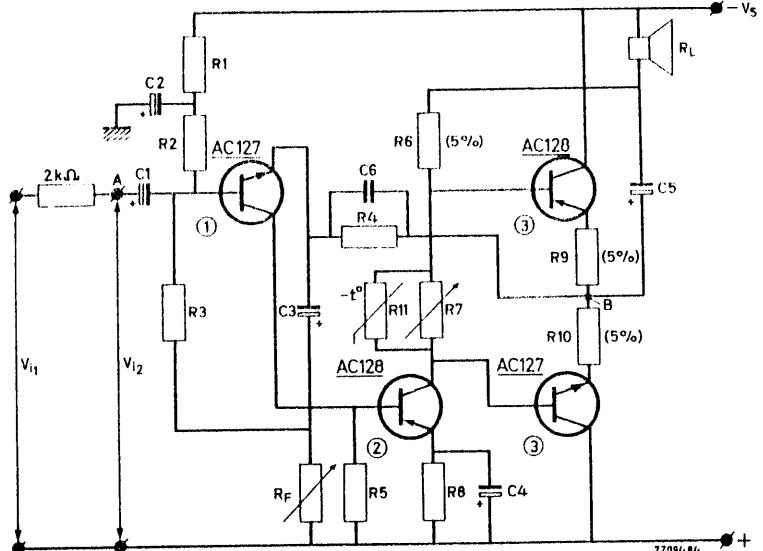
Stable continuous operation is ensured up to $T_{amb} = 45^\circ\text{C}$, provided the output transistors are mounted as indicated in the following table

	I	II	III	IV
AC127	A	C	B	C
AC128	A	A	A	B

A = without cooling fin or heatsink in free air

B = with cooling fin (Type No.56227)

C = with cooling fin (Type No.56227) mounted on a 1.5 mm aluminium heatsink of at least 12.5 cm^2



List of components	Circuit	I	II	III	IV
R1		1.2	2.7	6.8	2.2 kΩ
R2		22	18	33	18 kΩ
R3		15	15	22	15 kΩ
R4		2.2	2.2	3.3	2.2 kΩ
R5		1.5	2.2	1.8	1.5 kΩ
R6 (5%)		560	270	750	510 Ω
R7		100	75	75	100 Ω
R8		68	75	100	39 Ω
R9 = R10 (5%)		1.5	0	2.4	0 Ω
R11 (NTC)		-	130	-	130 Ω
R _L		8	4	10	8 Ω
R _F		0	0	0	0
R _{F'}		5.6	12	5.6	2.7 Ω
C1		6.4	6.4	6.4	6.4 μF
C2		100	100	100	100 μF
C3		320	125	320	400 μF
C4		200	160	125	200 μF
C5		400	1000	320	400 μF
C6		-	3900	-	- pF

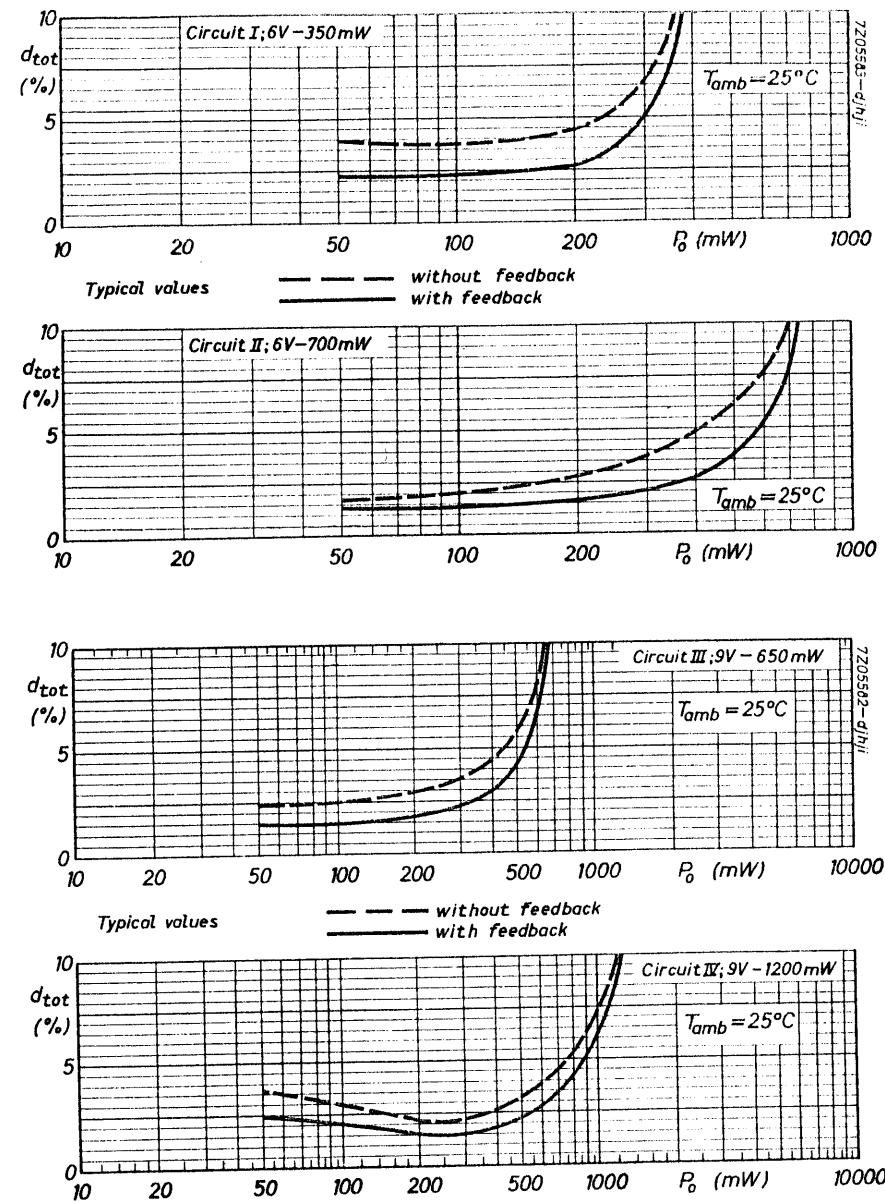
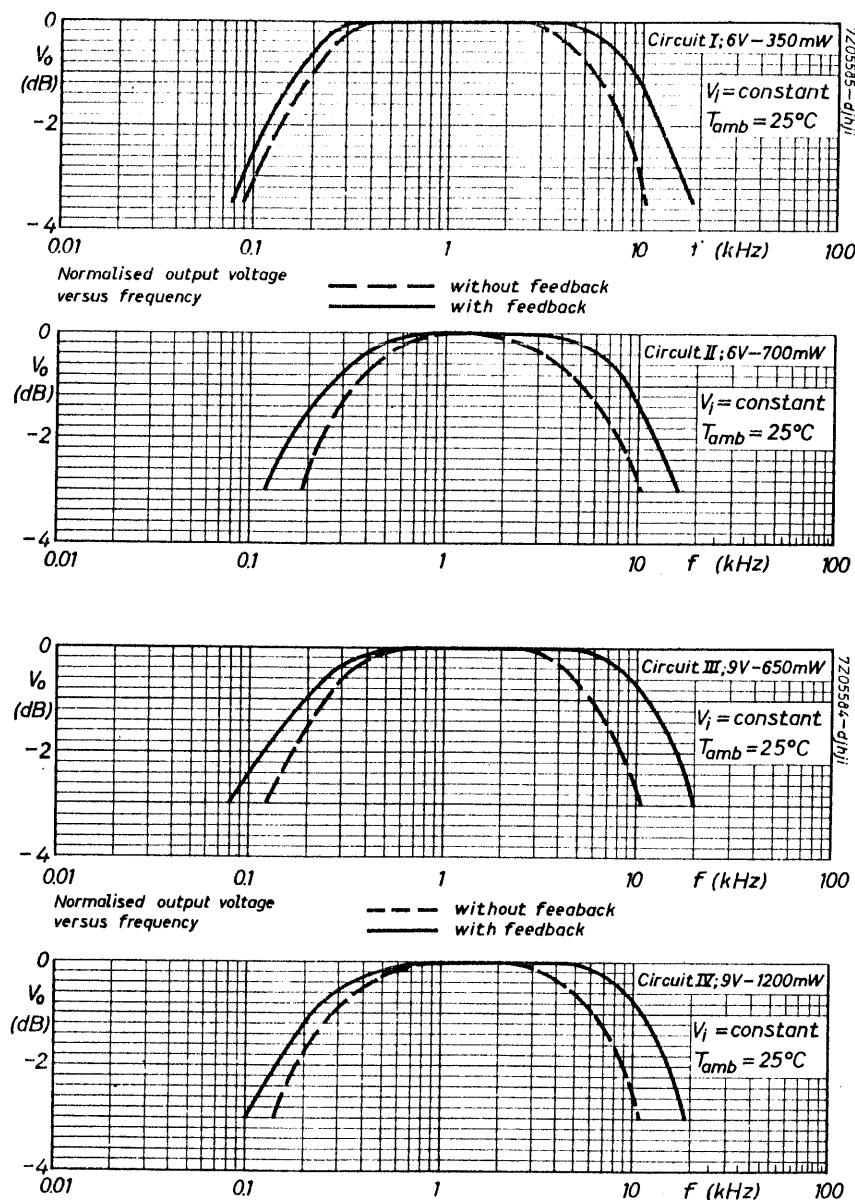
without feedback

with 6 dB feedback

Tolerance of resistors:

10 % unless otherwise
specified

¹⁾ To be adjusted with R7



TRANSISTORI AL GERMANIO
PER ALTA FREQUENZA

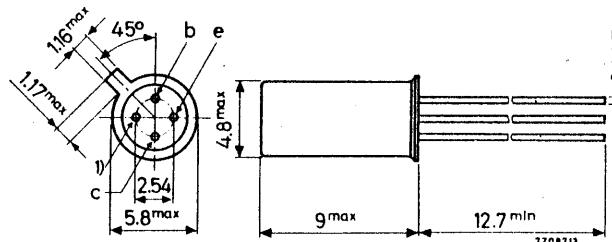
R.F. GERMANIUM ALLOY-DIFFUSED TRANSISTOR

P-N-P transistor in a metal envelope with insulated leads and a shield lead connected to the case. It is intended for application at frequencies up to 100 MHz.

QUICK REFERENCE DATA			
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	25 V
Collector-emitter voltage $R_B/R_E < 100; R_E > 200 \Omega$	$-V_{CE}$	max.	25 V
Collector current (peak value)	$-I_{CM}$	max.	15 mA
Total power dissipation up to $T_{amb} = 45^\circ\text{C}$	P_{tot}	max.	140 mW
Junction temperature, incidentally	T_j	max.	90 $^\circ\text{C}$
Feedback capacitance at $f = 0.45 \text{ MHz}$ $-I_C = 1 \text{ mA}; -V_{CE} = 10 \text{ V}$	$-C_{re}$	typ.	450 fF
Transition frequency $-I_C = 3 \text{ mA}; -V_{CE} = 10 \text{ V}$	f_T	typ.	270 MHz
Transfer admittance at $f = 35 \text{ MHz}$ $-I_C = 3 \text{ mA}; -V_{CE} = 10 \text{ V}$	$ y_{fe} $	typ.	80 $\text{m}\Omega^{-1}$

MECHANICAL DATA

Dimensions in mm



1=shield lead (connected to case)

Accessories available: 56246, 56263

RATINGS (Limiting values)¹⁾Voltages

Collector-base voltage (open emitter)

 $-V_{CBO}$ max. 25 V

Collector-emitter voltage

 $R_B/R_E < 100$; $R_E > 200 \Omega$ $-V_{CE}$ max. 25 VCurrents

Collector current (d.c.)

 $-I_C$ max. 10 mA

Collector current (peak value)

 $-I_{CM}$ max. 15 mA

Reverse emitter current

 $-I_E$ max. 1 mAPower dissipationTotal power dissipation up to $T_{amb} = 45^\circ\text{C}$
with cooling clip 56263 P_{tot} max. 140 mWTemperatures

Storage temperature

 T_{stg} -55 to $+75^\circ\text{C}$

Junction temperature: continuous

 T_j max. 75°C

incidentally

 T_j max. 90°C **THERMAL RESISTANCE**

From junction to ambient in free air

 $R_{th j-a} = 0.45^\circ\text{C}/\text{mW}$

From junction to case

 $R_{th j-c} = 0.22^\circ\text{C}/\text{mW}$ From junction to ambient with cooling
clip 56263 $R_{th j-a} = 0.32^\circ\text{C}/\text{mW}$ **CHARACTERISTICS** $T_{amb} = 25^\circ\text{C}$ unless otherwise specifiedCollector cut-off current $I_E = 0$; $-V_{CB} = 10$ V $-I_{CBO}$ typ. $<$ $1.2 \mu\text{A}$
 $8 \mu\text{A}$ $I_E = 0$; $-V_{CB} = 10$ V; $T_j = 75^\circ\text{C}$ $-I_{CBO}$ typ. $<$ $150 \mu\text{A}$ Base current $-I_C = 3$ mA; $-V_{CE} = 10$ V $-I_B$ typ. $<$ $40 \mu\text{A}$
 $100 \mu\text{A}$ Base-emitter voltage $-I_C = 3$ mA; $-V_{CE} = 10$ V $-V_{BE}$ typ. 320 mV
 280 to 380 mVFeedback capacitance at $f = 0.45$ MHz $-I_C = 1$ mA; $-V_{CE} = 10$ V $-C_{re}$ typ. 450 fF¹⁾
 250 to 650 fF¹⁾Transition frequency $-I_C = 3$ mA; $-V_{CE} = 10$ V f_T typ. 270 MHzNoise figure at $f = 100$ MHz²⁾ $I_E = 2$ mA; $-V_{CB} = 5$ V F typ. $<$ 4.5 dB
 6 dBy parameters at $f = 0.45$ MHz (common emitter)³⁾ $-I_C = 2$ mA; $-V_{CE} = 5$ V g_{ie} typ. $0.8 \text{ m}\Omega^{-1}$

Input conductance

 C_{ie} typ. 45 pF

Input capacitance

 $|y_{re}|$ typ. $1.7 \mu\Omega^{-1}$

Feedback admittance

 φ_{re} typ. 270°

Phase angle of feedback admittance

 $|y_{fe}|$ typ. $73 \text{ m}\Omega^{-1}$

Transfer admittance

 φ_{fe} typ. 0

Phase angle of transfer admittance

 g_{oe} typ. $0.8 \mu\Omega^{-1}$

Output conductance

 C_{oe} typ. 2.7 pF

Output capacitance

¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.¹⁾ $1 \text{ fF} = 1 \text{ femtofarad} = 10^{-15} \text{ F}$ ²⁾ To obtain minimum noise figure the terminating admittance at the input of the transistor shall be $Y_S = (11-6j) \text{ m}\Omega^{-1}$ ³⁾ Length of leads between bottom of transistor and measuring jig is 5 mm

CHARACTERISTICS (continued)

y parameters at $f = 5.5$ MHz (common emitter) ¹⁾ $-I_C = 2$ mA; $-V_{CE} = 5$ V

Input conductance	g_{ie}	typ.	$1.0 \text{ m}\Omega^{-1}$
Input capacitance	C_{ie}	typ.	45 pF
Feedback admittance	$ y_{re} $	typ.	$21 \mu\Omega^{-1}$
Phase angle of feedback admittance	φ_{re}	typ.	270°
Transfer admittance	$ y_{fe} $	typ.	$71 \text{ m}\Omega^{-1}$
Phase angle of transfer admittance	φ_{fe}	typ.	350°
Output conductance	g_{oe}	typ.	$5 \mu\Omega^{-1}$
Output capacitance	C_{oe}	typ.	2.6 pF

y parameters at $f = 10.7$ MHz (common emitter) ¹⁾ $-I_C = 2$ mA; $-V_{CE} = 5$ V

Input conductance	g_{ie}	typ.	$1.3 \text{ m}\Omega^{-1}$
Input capacitance	C_{ie}	typ.	45 pF
Feedback admittance	$ y_{re} $	typ.	$40 \mu\Omega^{-1}$
Phase angle of feedback admittance	φ_{re}	typ.	270°
Transfer admittance	$ y_{fe} $	typ.	$70 \text{ m}\Omega^{-1}$
Phase angle of transfer admittance	φ_{fe}	typ.	347°
Output conductance	g_{oe}	typ.	$13 \mu\Omega^{-1}$
Output capacitance	C_{oe}	typ.	2.5 pF

y parameters at $f = 35$ MHz (common emitter) ¹⁾ $-I_C = 3$ mA; $-V_{CE} = 10$ V

Input conductance	g_{ie}	typ.	$6.5 \text{ m}\Omega^{-1}$
Input capacitance	C_{ie}	typ.	35 pF
Feedback admittance	$ y_{re} $	typ.	$100 \mu\Omega^{-1}$
Phase angle of feedback admittance	φ_{re}	typ.	260°
Transfer admittance	$ y_{fe} $	typ.	$80 \text{ m}\Omega^{-1}$
Phase angle of transfer admittance	φ_{fe}	typ.	322°
Output conductance	g_{oe}	typ.	$100 \mu\Omega^{-1}$
Output capacitance	C_{oe}	typ.	$1:8 \text{ pF}$

¹⁾ Length of leads between bottom of transistor and measuring jig is 5 mm. $T_{amb} = 25^\circ\text{C}$

CHARACTERISTICS (continued)

y parameters at $f = 100$ MHz (common base) ¹⁾ $I_E = 2$ mA; $-V_{CB} = 5$ V

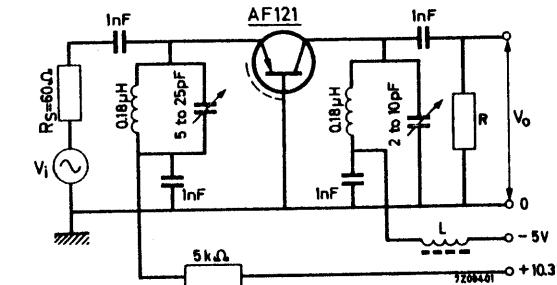
Input conductance	g_{ib}	typ.	$32 \text{ m}\Omega^{-1}$
Input capacitance	$-C_{ib}$	typ.	35 pF
Feedback admittance	$ y_{rb} $	typ.	$320 \mu\Omega^{-1}$
Phase angle of feedback admittance	φ_{rb}	typ.	240°
Transfer admittance	$ y_{fb} $	typ.	$34 \text{ m}\Omega^{-1}$
Phase angle of transfer admittance	φ_{fb}	typ.	110°
Output conductance	g_{ob}	typ.	$250 \mu\Omega^{-1}$
Output capacitance	C_{ob}	typ.	1.6 pF

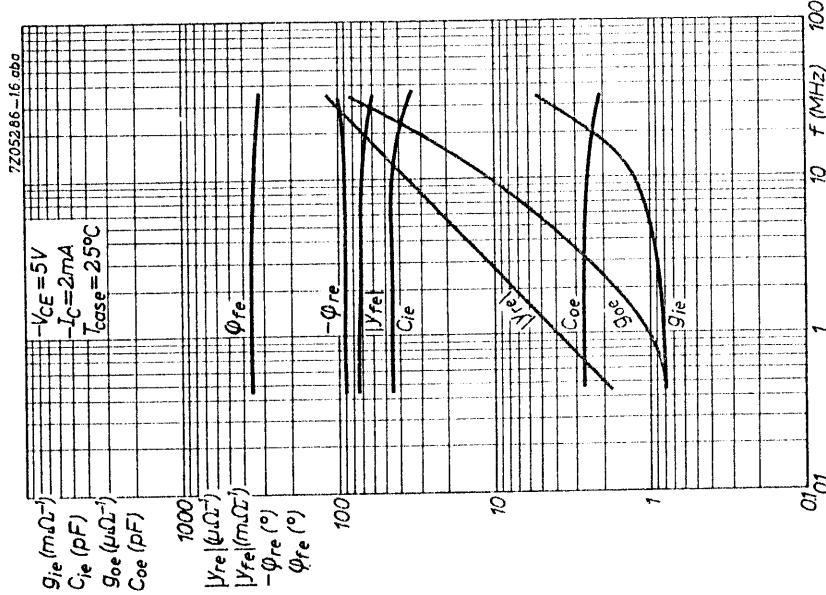
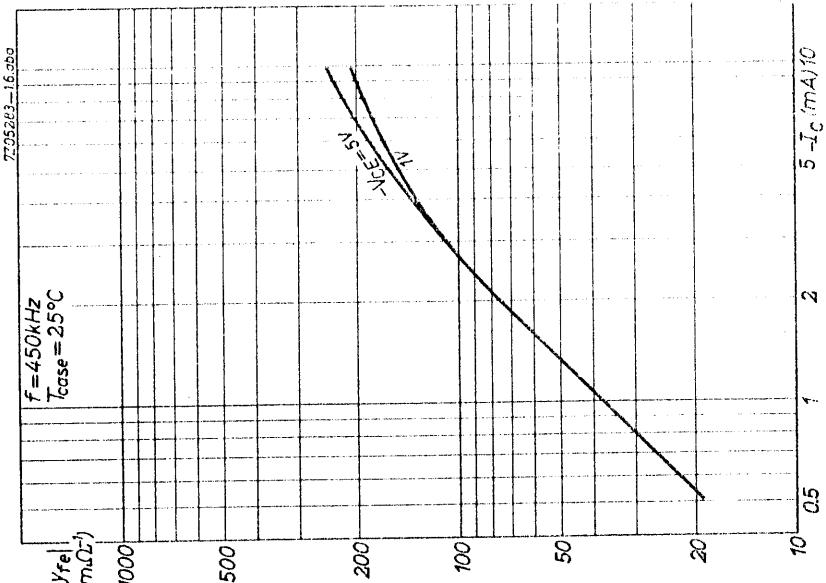
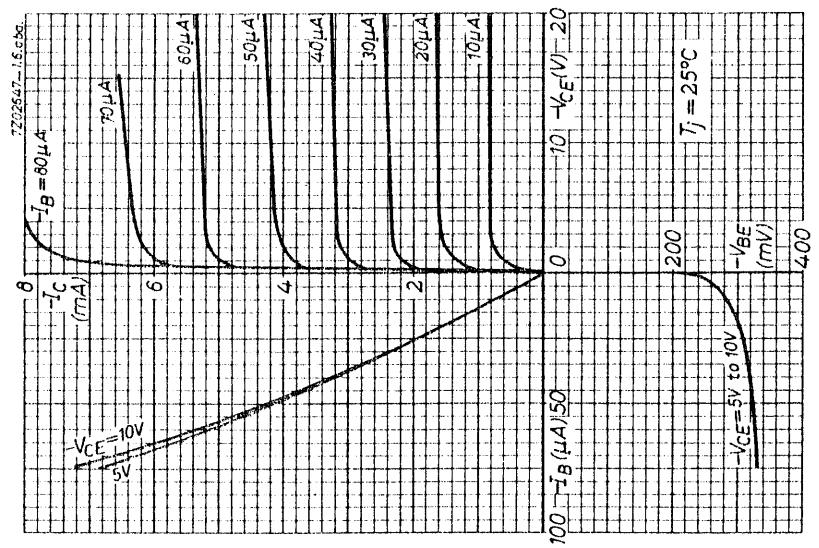
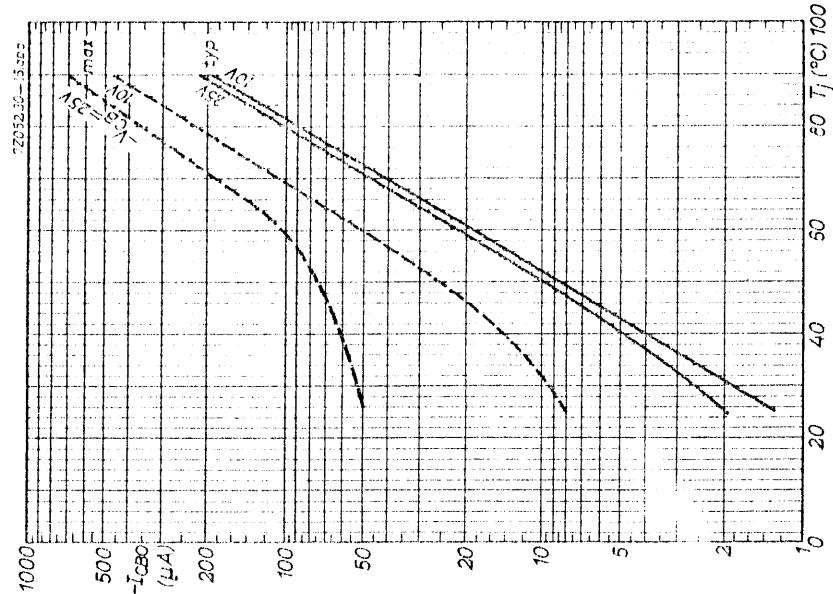
Transducer gain

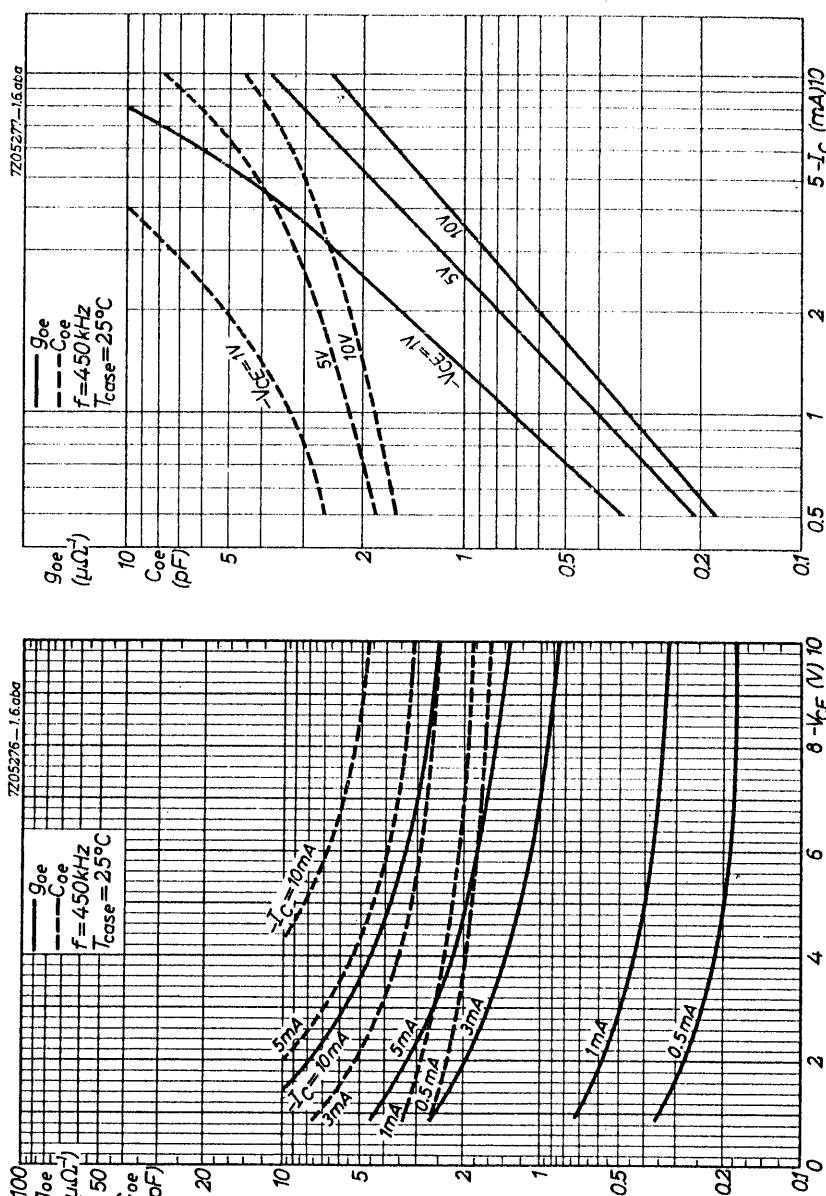
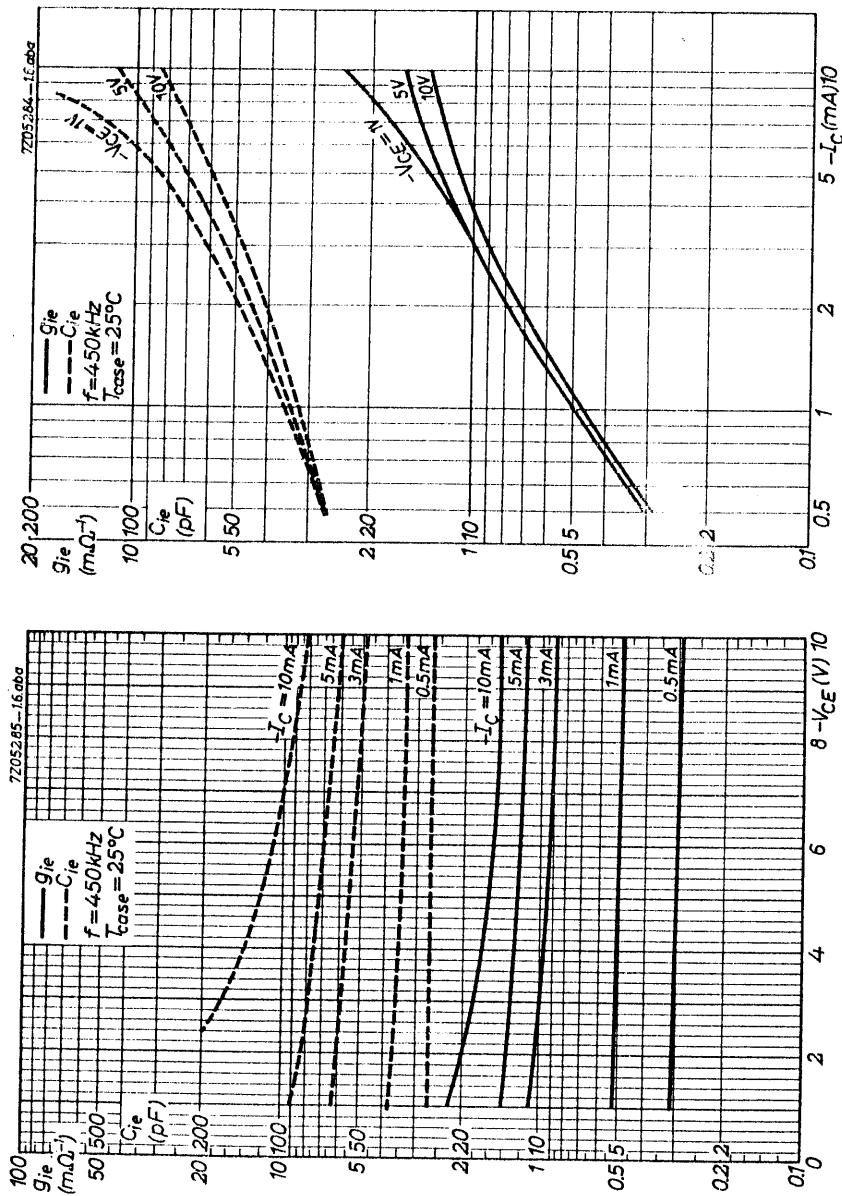
$$G_{tr} = \frac{\text{output power in load } R_L}{\text{available power from source } R_S}$$

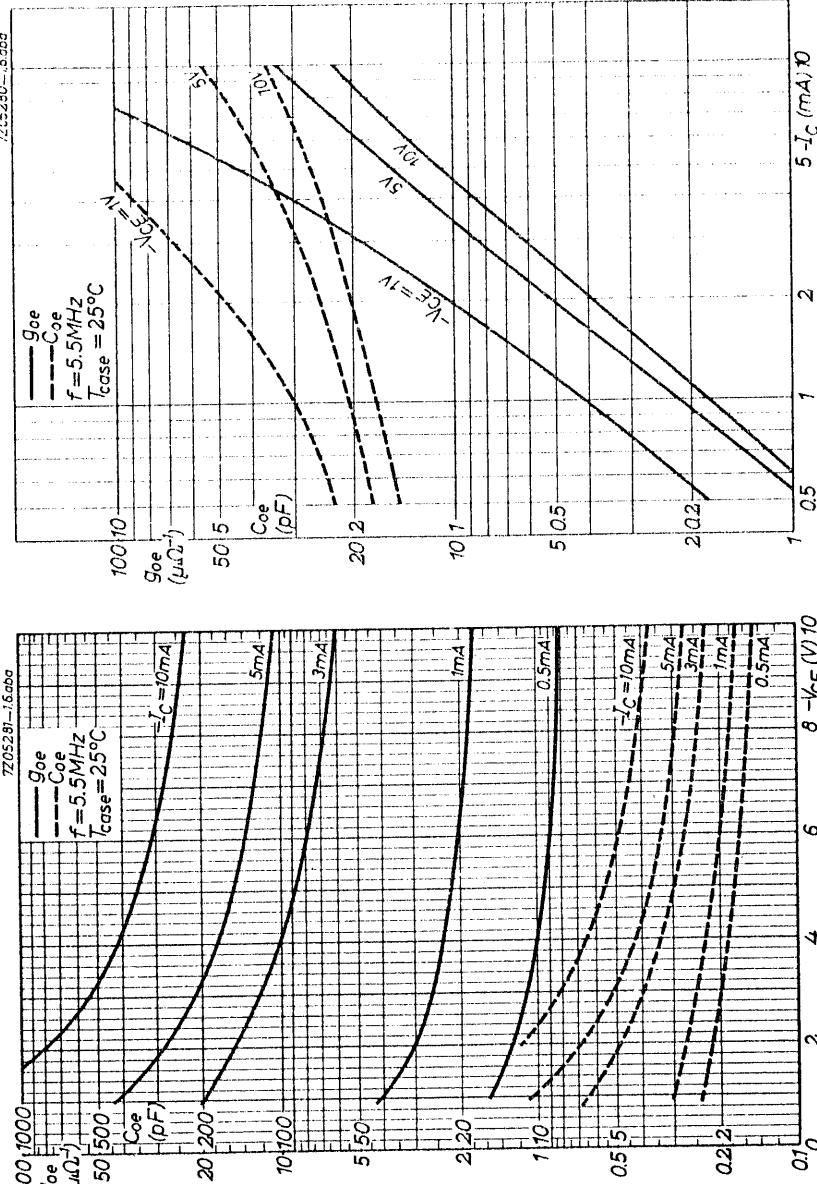
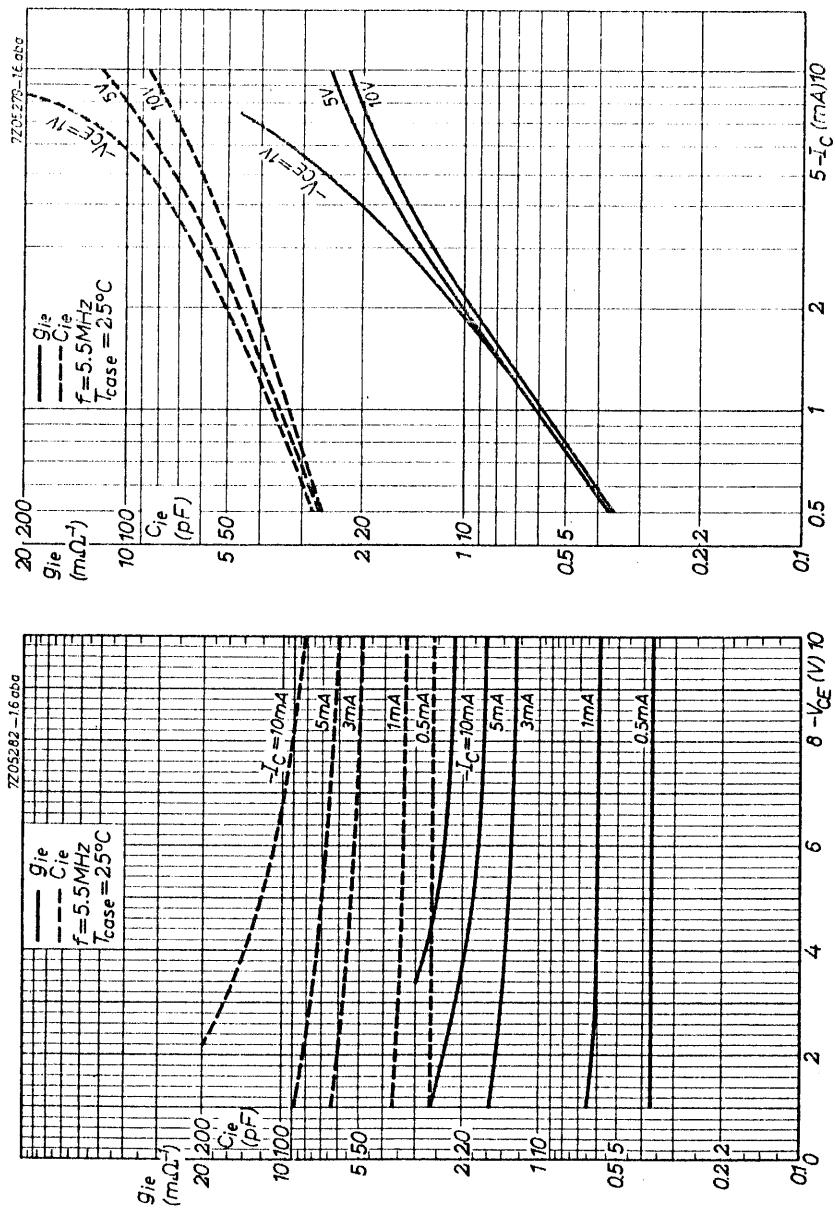
 $I_E = 2$ mA; $-V_{CB} = 5$ V; $f = 100$ MHz $G_{tr} > 17 \text{ dB}$
typ. 19 dB

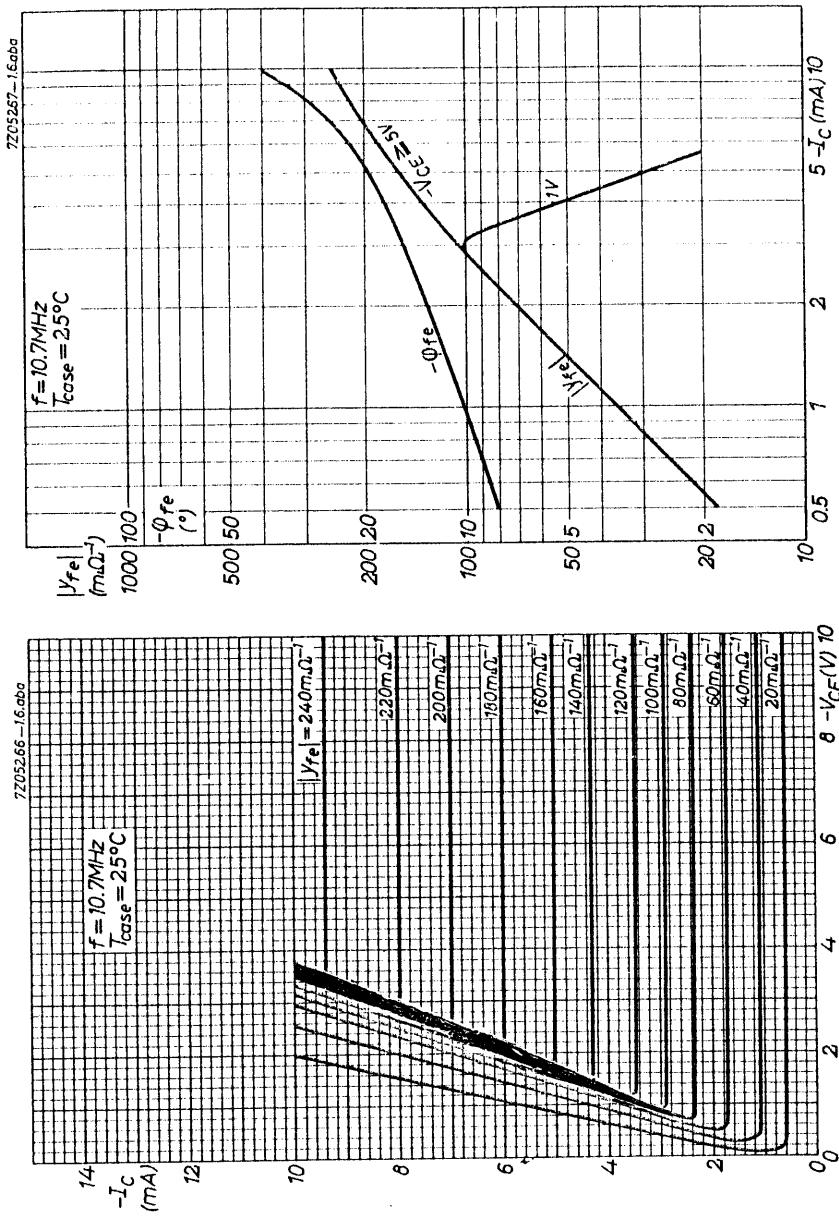
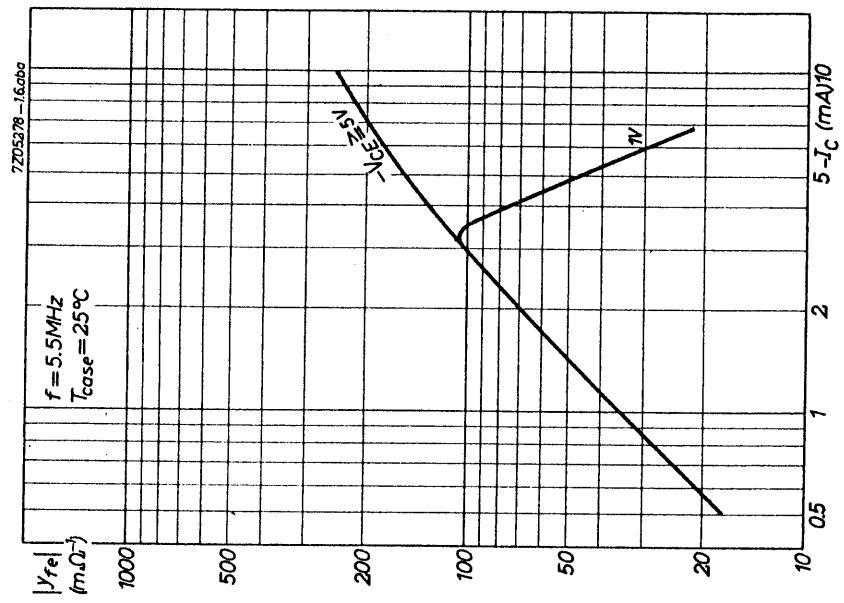
Basic circuit for measuring the transducer gain

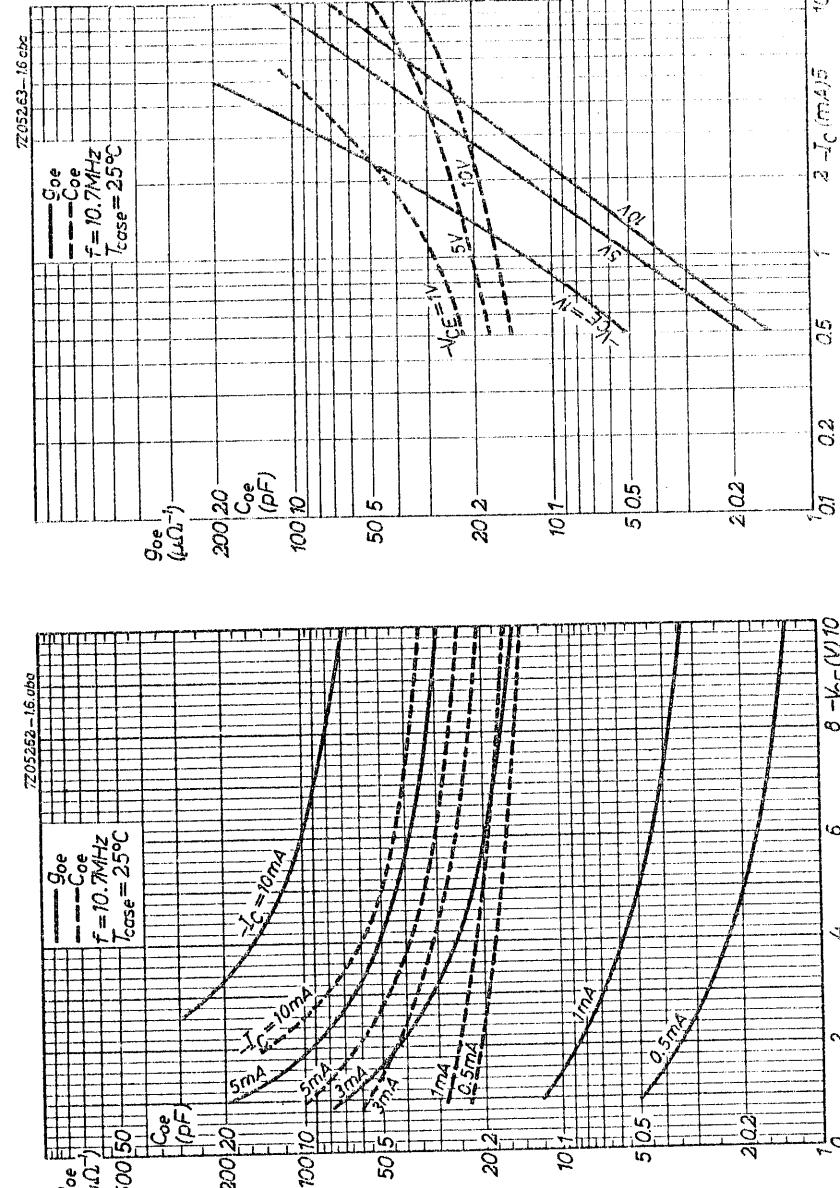
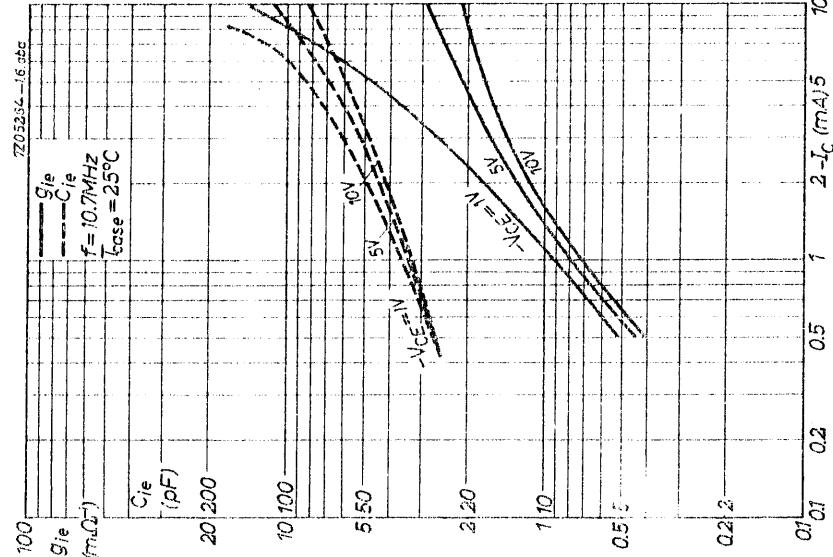
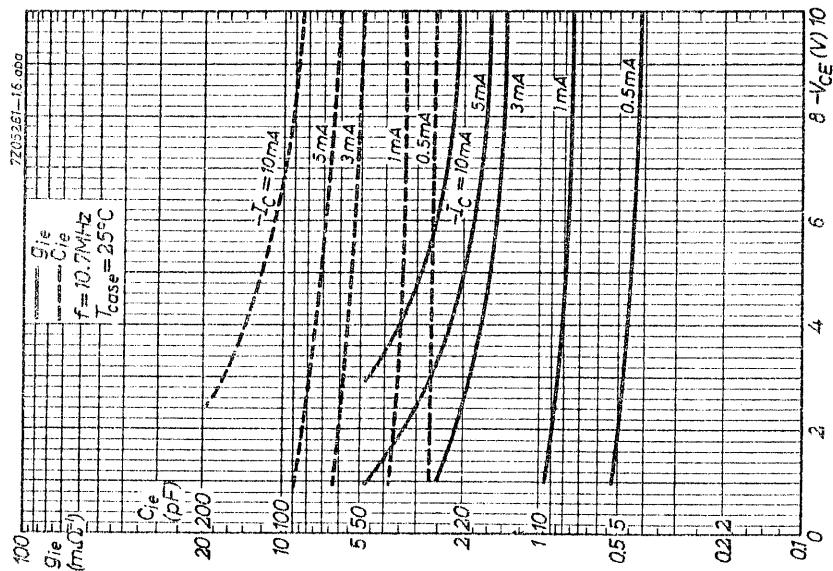
The resistor R is chosen such that the total load, consisting of R and the tuned circuit in parallel, $R_L = 3.3 \text{ k}\Omega$ L is a ferrite wide-band choke¹⁾ Length of leads between bottom of transistor and measuring jig is 5 mm.

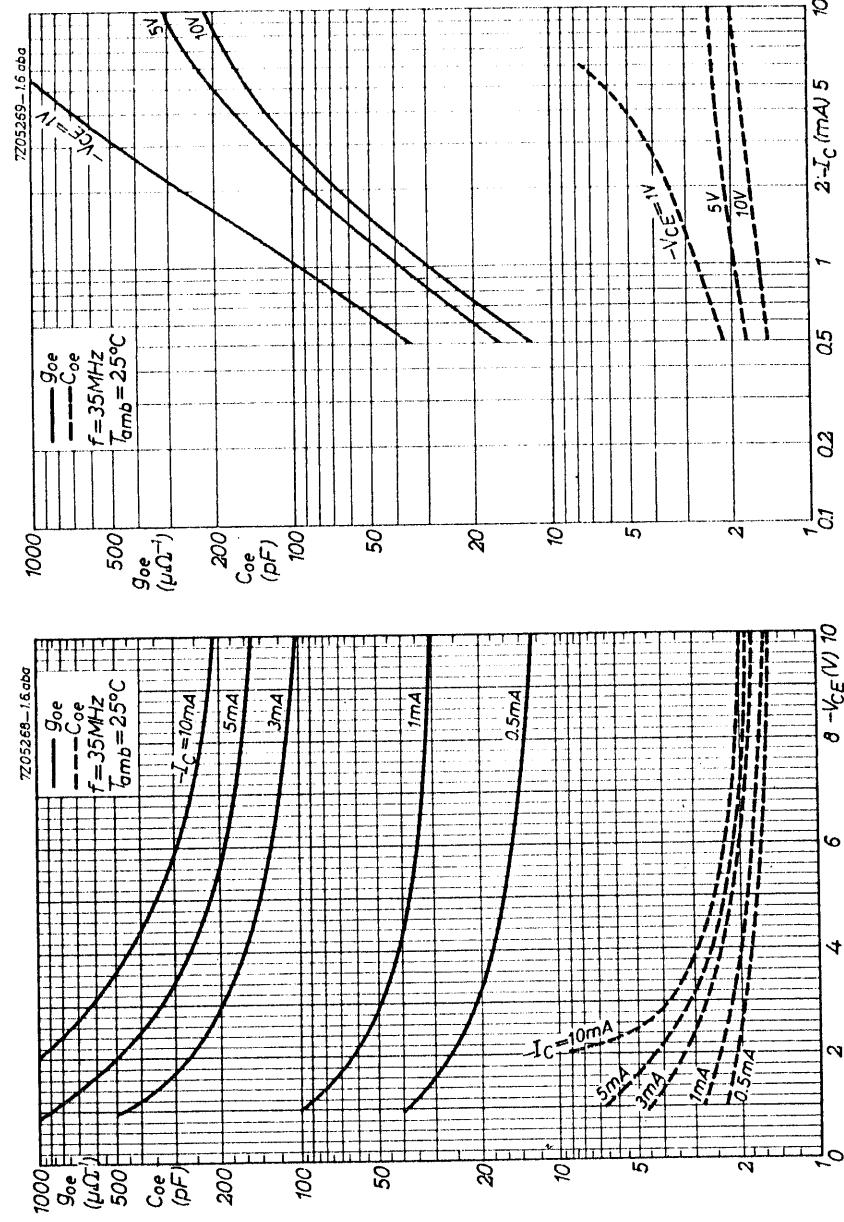
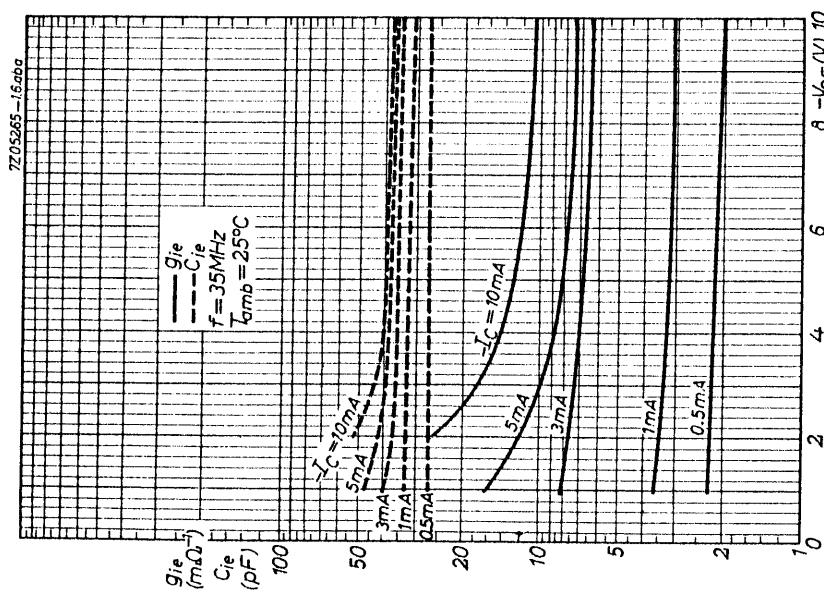


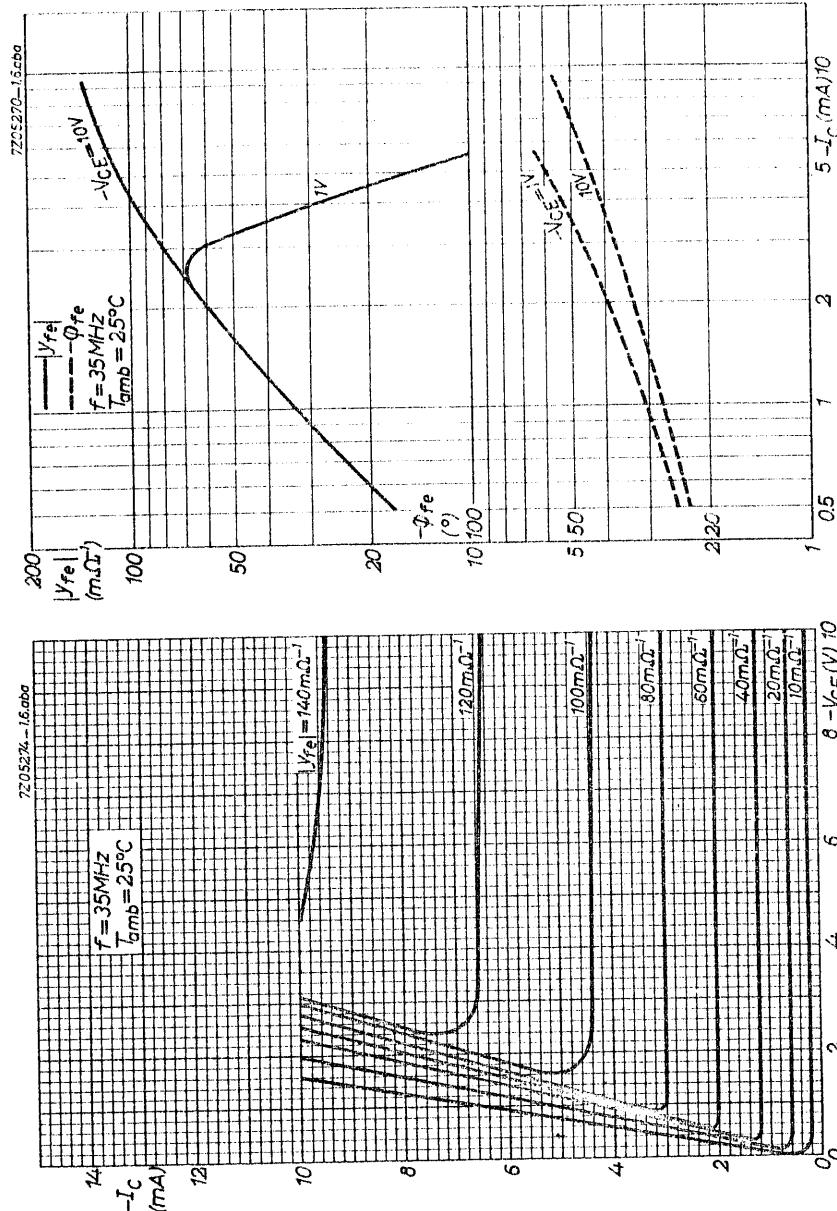
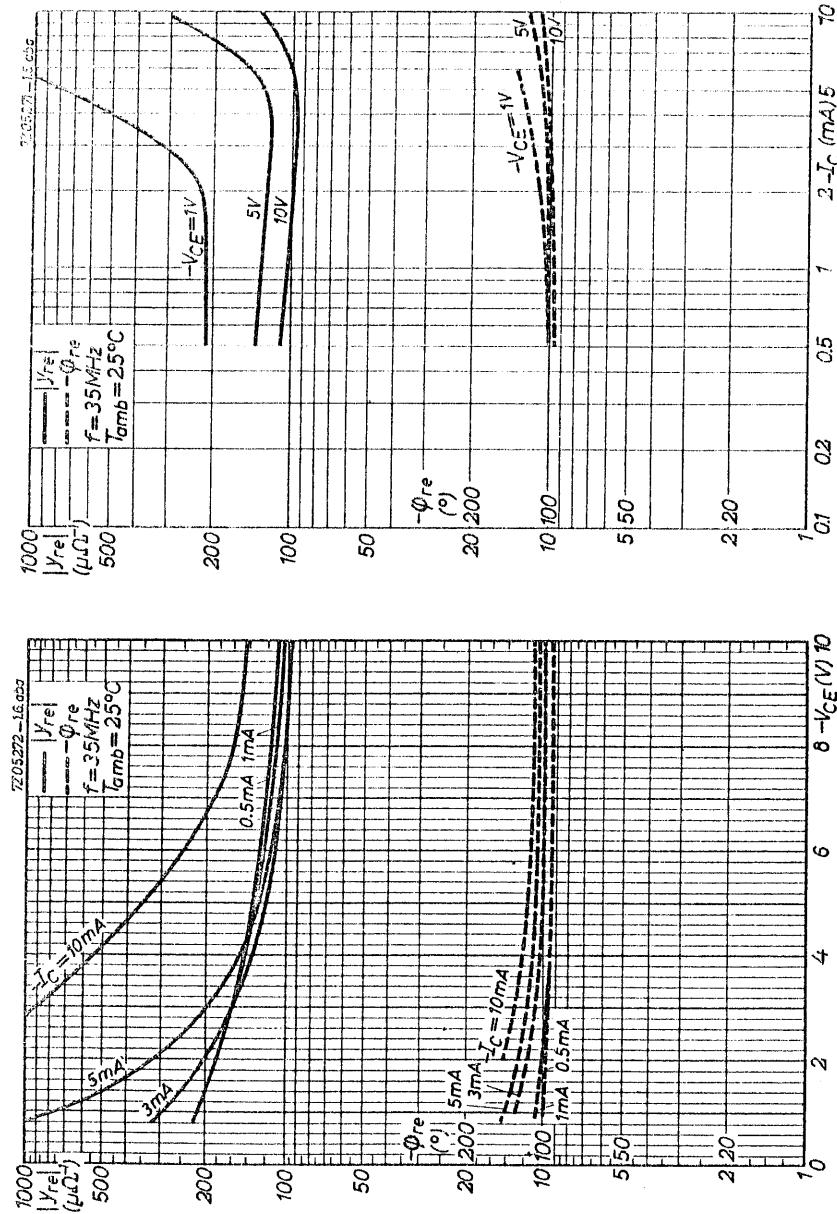


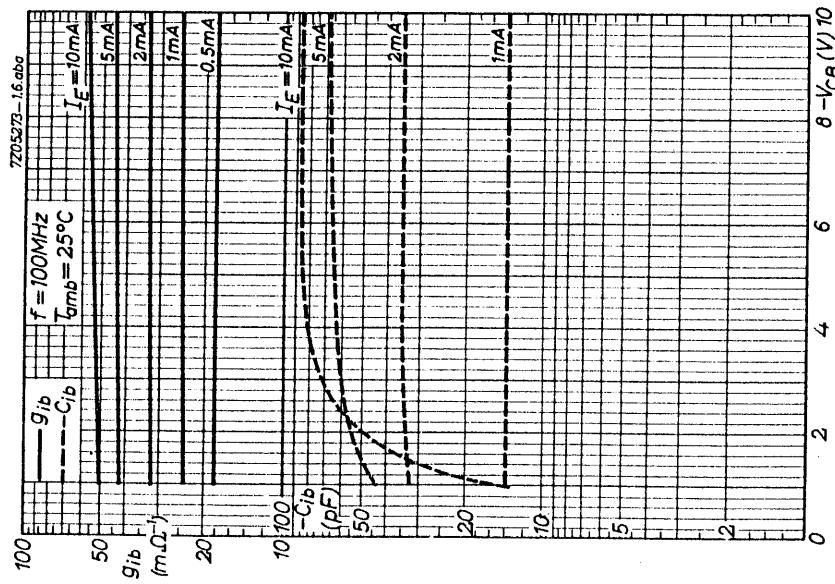






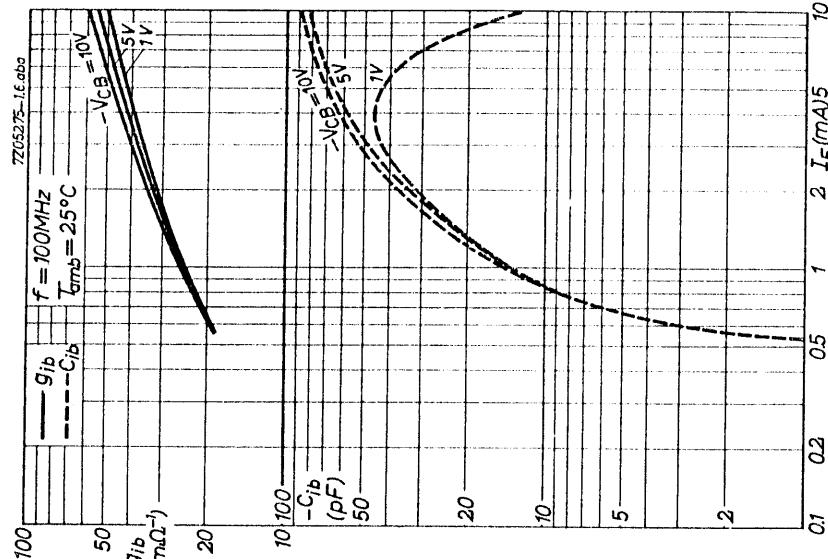






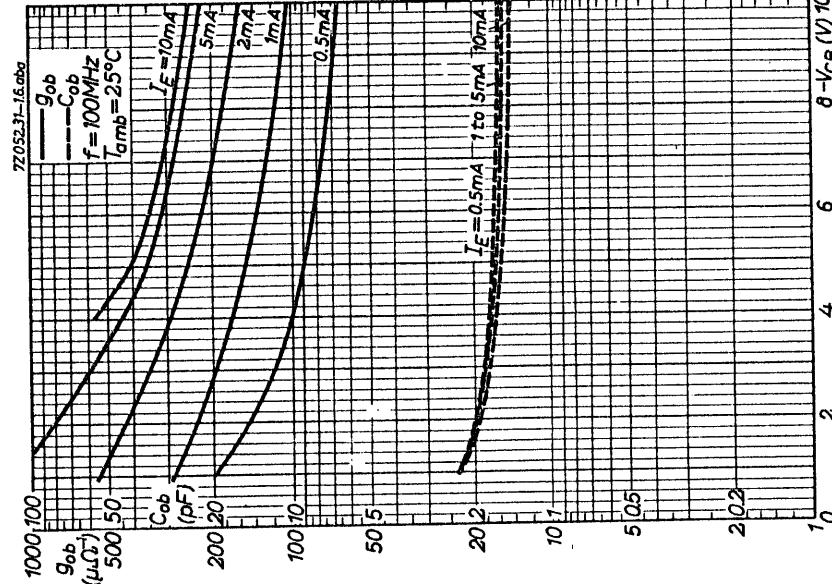
200

May 1968



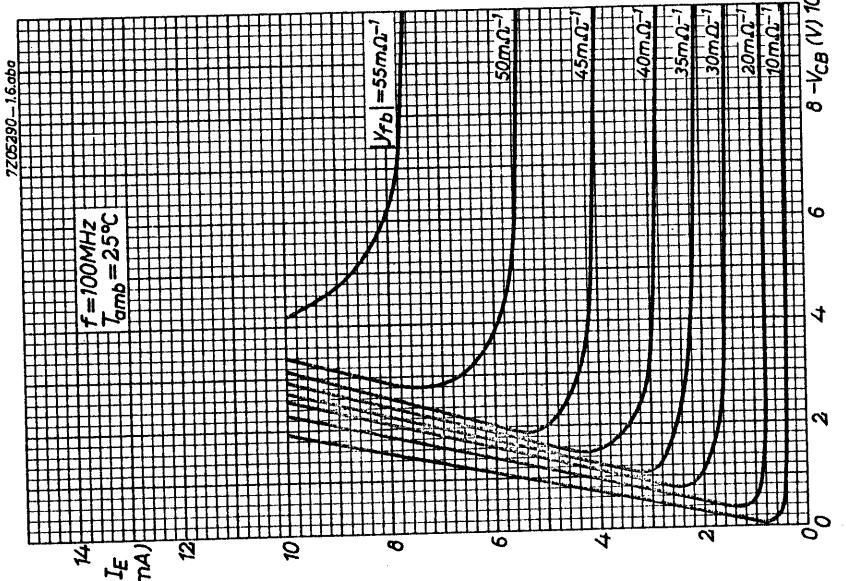
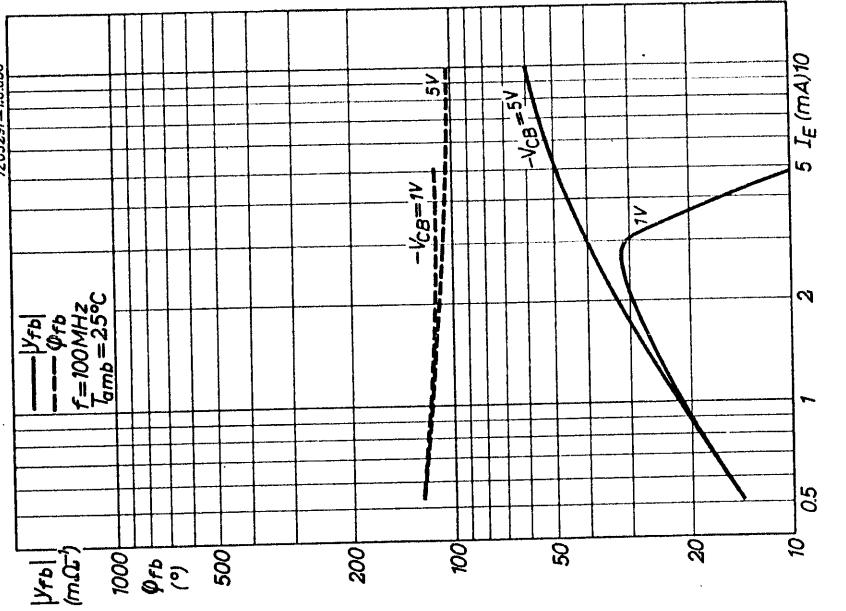
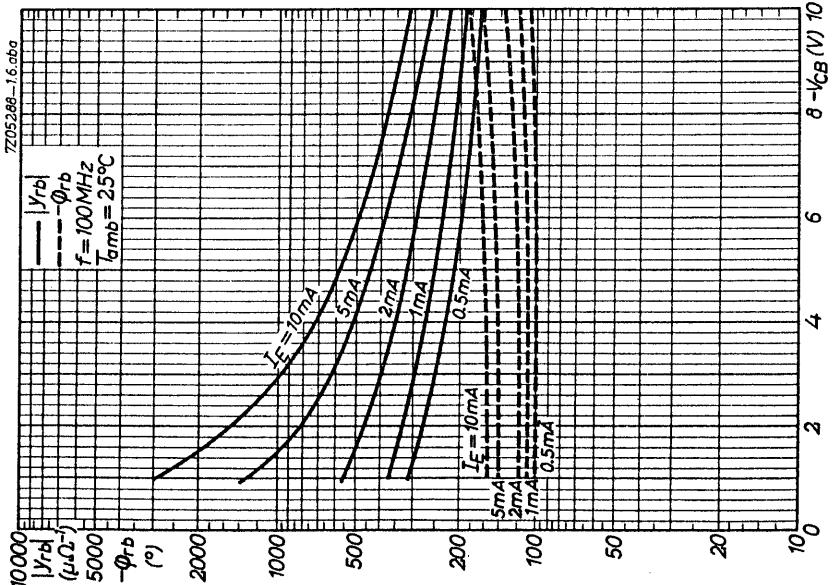
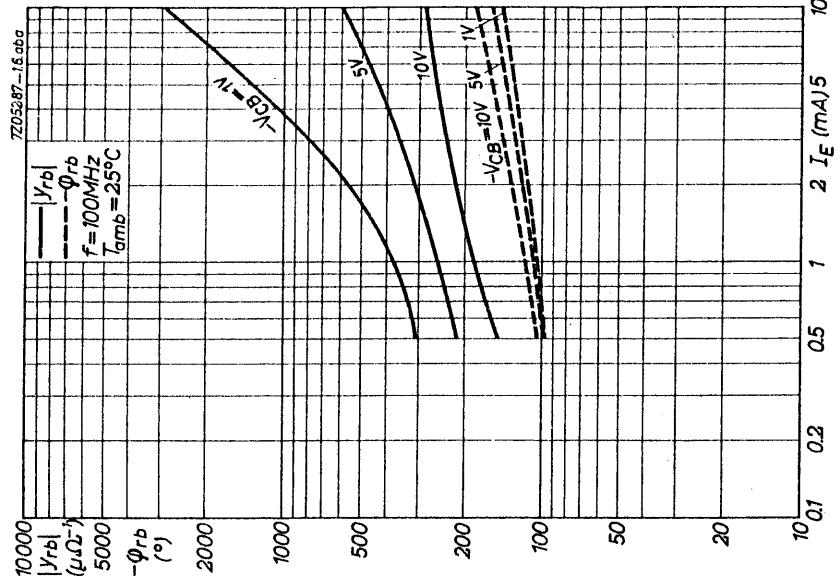
May 1968

201



May 1968

201



GERMANIUM ALLOY DIFFUSED TRANSISTOR

P-N-Ptransistor in a TO-72 metal envelope with a shieldlead connected to the case. It has low noise and high power gain up to frequencies of 100 MHz and is intended for use as r.f. amplifier in f.m. receivers.

RATINGS (Limiting values)¹⁾

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	32	V
Collector-emitter voltage ($Z_B/Z_E < 15$)	$-V_{CER}$	max.	32	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15	V
Collector current (d.c.)	$-I_C$	max.	10	mA
Base current (d.c.)	$ I_B $	max.	1	mA
Reverse emitter current	$-I_E$	max.	1	mA
Total power dissipation up to $T_{amb} = 45^{\circ}\text{C}$	P_{tot}	max.	60	mW
Storage temperature	T_{stg}	-55 to +75	$^{\circ}\text{C}$	
Junction temperature: continuous	T_j	max.	75	$^{\circ}\text{C}$
incidentally	T_j	max.	90	$^{\circ}\text{C}$

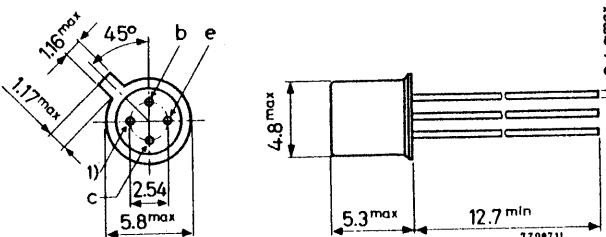
THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j-a}$	=	0.75	$^{\circ}\text{C}/\text{mW}$
From junction to case	$R_{th\ j-c}$	=	0.4	$^{\circ}\text{C}/\text{mW}$

Dimensions in mm

MECHANICAL DATA

TO-72



1) = shield lead (connected to case)

Accessories available: 56246, 56263

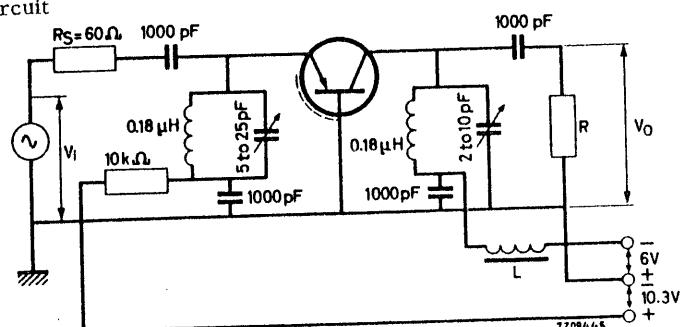
1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS $T_{amb} = 25^{\circ}\text{C}$ unless otherwise specifiedCollector cut-off current $I_E = 0; -V_{CB} = 6 \text{ V}$
 $-I_{CBO}$ typ. 1.2 μA
 $<$ 8 μA
 $I_E = 0; -V_{CB} = 6 \text{ V}; T_j = 75^{\circ}\text{C}$
 $-I_{CBO}$ typ. 90 μA
 $<$ 180 μA
Base current $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$
 $-I_B$ typ. 7 μA
 $<$ 25 μA
Base-emitter voltage $-I_C = 1 \text{ mA}; -V_{CE} = 6 \text{ V}$
 $-V_{BE}$ typ. 270 mV
 210 to 330 mV
Small signal current gain at $f = 1 \text{ kHz}$ $-I_C = 1 \text{ mA}; -V_{CE} = 6 \text{ V}$ h_{fe} typ. 150Feedback capacitance at $f = 450 \text{ kHz}$ $-I_C = 1 \text{ mA}; -V_{CE} = 6 \text{ V}$ $-C_{re}$ typ. 1.5 pFy parameters at $f = 100 \text{ MHz}$ (common base) $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ ¹⁾

Input conductance
 Input capacitance
 Feedback admittance
 Phase angle of feedback admittance
 Transfer admittance
 Phase angle of transfer admittance
 Output conductance
 Output capacitance

 g_{ib} typ. 15 $\text{m}\Omega^{-1}$
 $-C_{ib}$ typ. 5 pF
 $|y_{rb}|$ typ. 0.45 $\text{m}\Omega^{-1}$
 φ_{rb} typ. 250°
 $|y_{fb}|$ typ. 16 $\text{m}\Omega^{-1}$
 φ_{fb} typ. 95°
 g_{ob} typ. 0.3 $\text{m}\Omega^{-1}$
 C_{ob} typ. 2.5 pF
Feedback impedance at $f = 2 \text{ MHz}$ $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ $|z_{rb}|$ typ. 20 Ω CHARACTERISTICS (continued) $T_{amb} = 25^{\circ}\text{C}$ unless otherwise specifiedTransition frequency $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ f_T typ. 75 MHzNoise figure at $f = 100 \text{ MHz}$ $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}; R_S = 60 \Omega$ F typ. 8 dB
 $<$ 9.5 dBPower gain at $f = 100 \text{ MHz}$

$$G_p = \frac{V_o^2}{V_i^2} \cdot \frac{4 R_S}{R_L} = 0.073 \frac{V_o^2}{V_i^2}$$

 G_p > 12.5 dB
 typ. 14 dBTest circuit

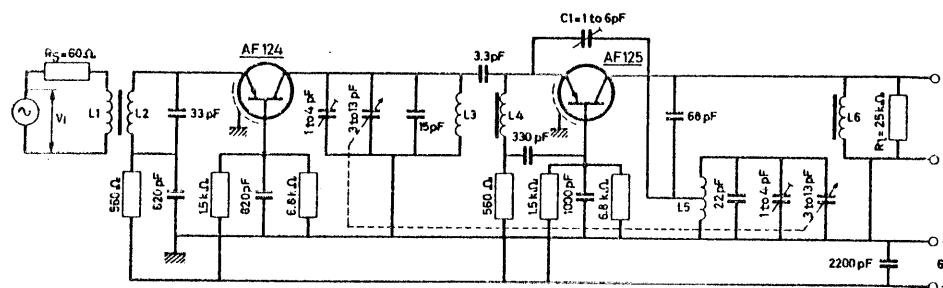
R is chosen such that the total load impedance R_1 consisting of R and the tuned circuit in parallel is 3.3 kΩ.

L = ferrite bead

¹⁾ Length of leads between transistor bottom and measuring jig: 5 mm

APPLICATION INFORMATION

Front-end unit of a f.m. tuner



The oscillator voltage at the emitter of the AF 125 should be adjusted to 80 mV by means of C1 at a battery voltage $V_S = 4$ V

$L_1 = 4.5$ turns enamelled Cu wire (0.3 mm), wound between L_2 .

$L_2 = 4$ turns enamelled Cu wire (1 mm), winding pitch 2 mm, inductance $0.18 \mu\text{H}$, unloaded Q-factor 60 to 80.

$L_3 = 3.25$ turns silvered Cu wire (1 mm), winding pitch 2 mm, inductance $0.086 \mu\text{H}$, unloaded Q-factor 200.

$L_4 = 6$ turns enamelled Cu wire (0.5 mm), closely wound, inductance $0.65 \mu\text{H}$.

$L_5 = 2.5$ turns silvered Cu wire (1 mm), winding pitch 2 mm, inductance $0.062 \mu\text{H}$, unloaded Q-factor > 200 ; tap at 1.125 turns from earth.

$L_6 = 18$ turns enamelled Cu wire (36×0.03), soldering graded, stranded, open covered, closely wound; inductance $2.9 \mu\text{H}$; unloaded Q-factor 120; loaded Q-factor with $25 \text{ k}\Omega : 60$.

Frequency range

f 87 to 101 MHz

Collector current AF124
AF125

$-I_C$ 1.4 mA
 $-I_C$ 1.5 mA

Total power gain

G_p > 24 dB
typ. 28 dB

Noise figure

F typ. 8 dB
< 9.5 dB

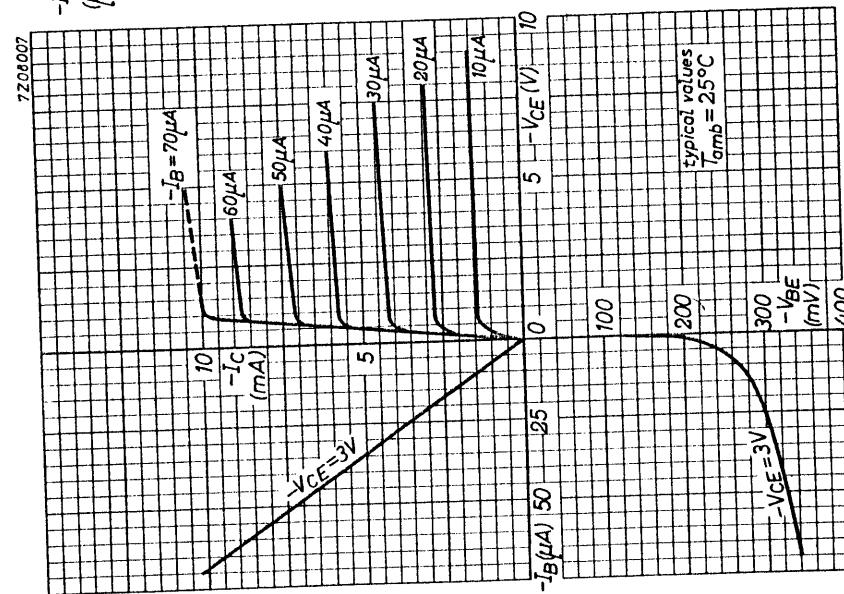
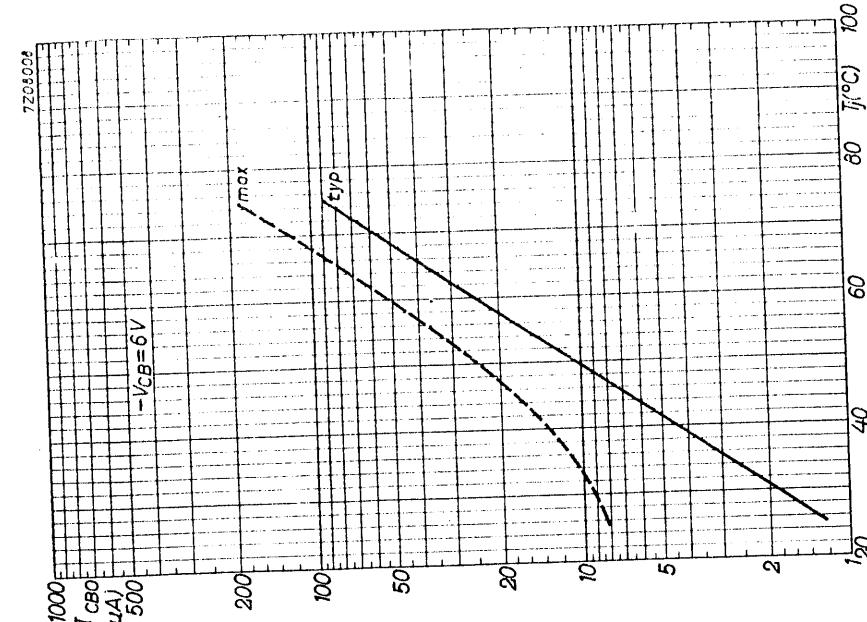
Oscillator voltage at aerial terminals

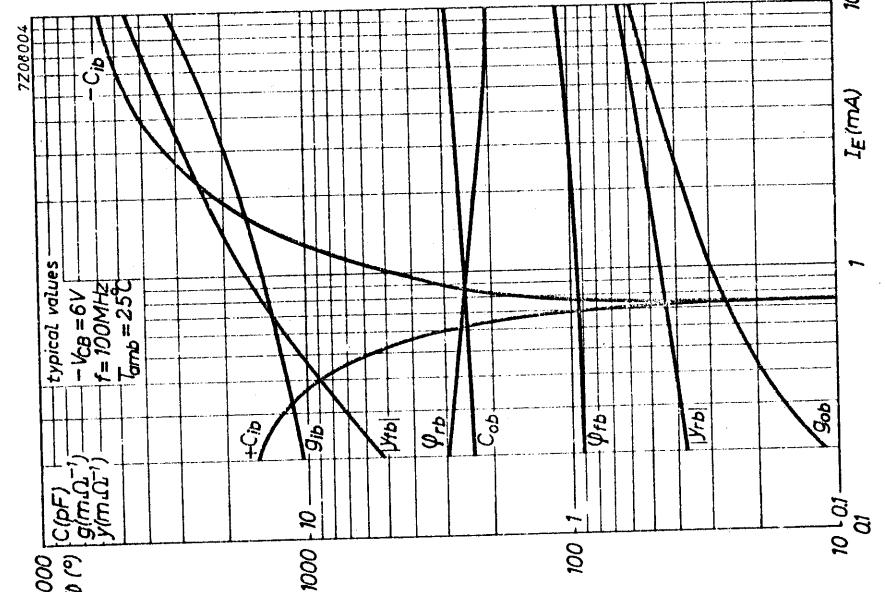
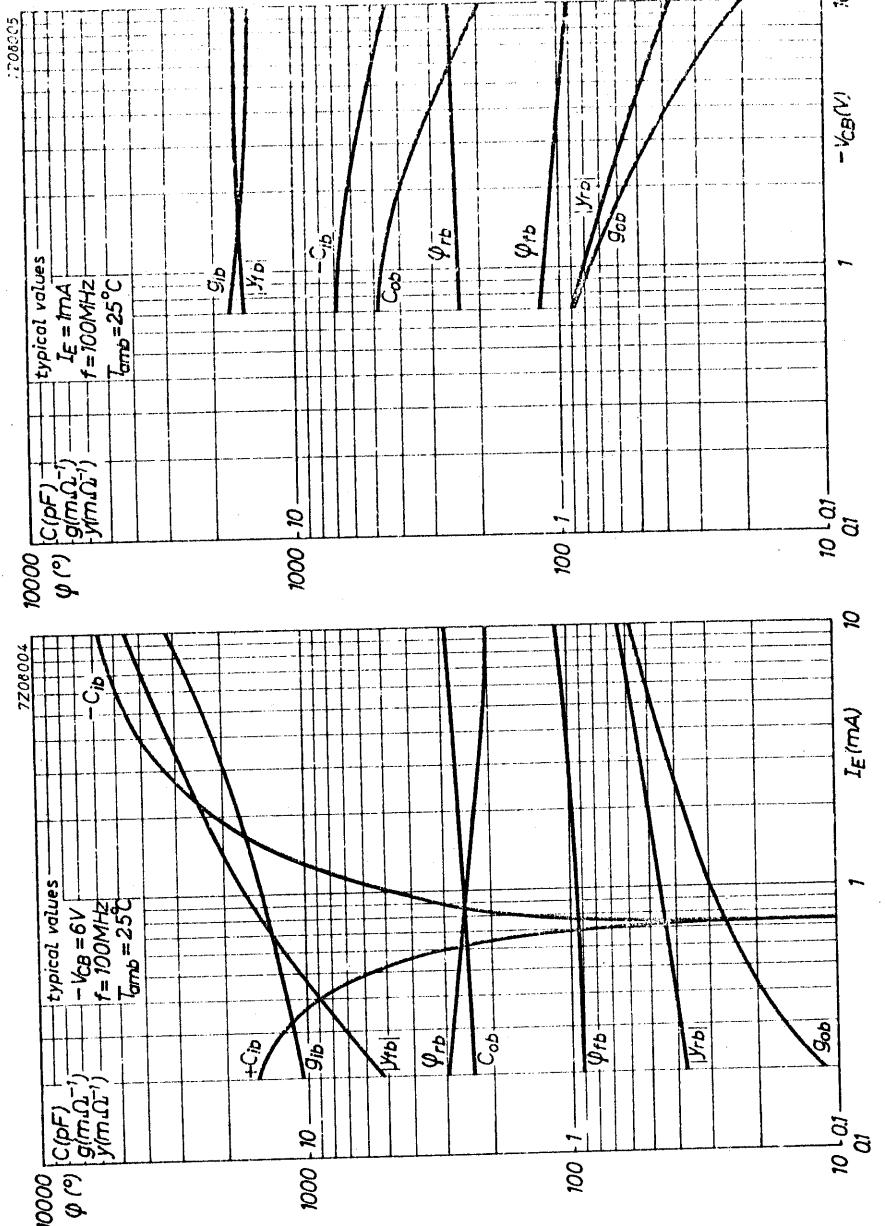
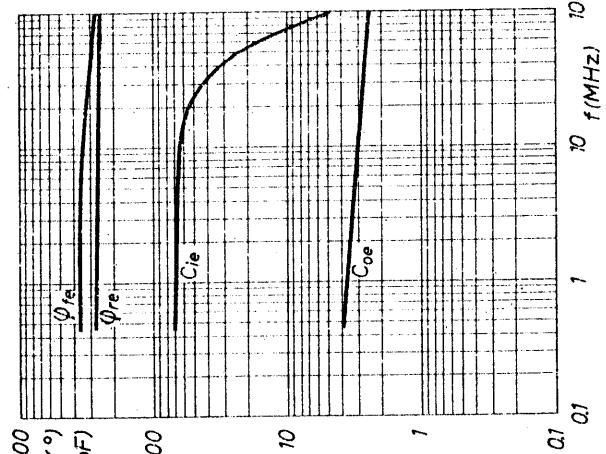
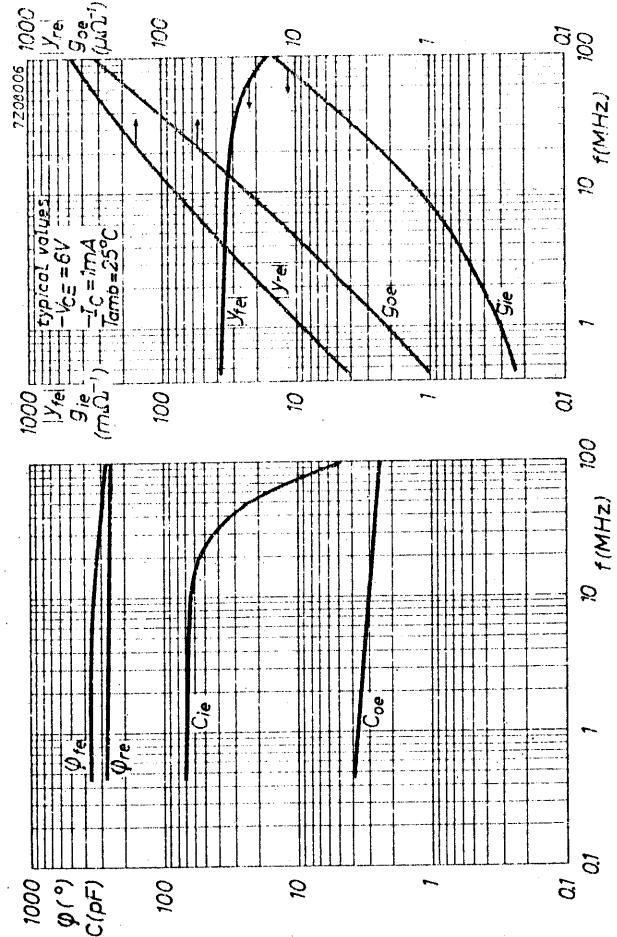
typ. 1.5 mV

Image rejection

typ. 27 dB

The shift of the oscillator frequency as a function of the battery voltage is about 50 kHz from 6 to 5 V and about 100 kHz from 5 to 4 V.





GERMANIUM ALLOY DIFFUSED TRANSISTOR

P-N-P transistor in a TO-72 metal envelope with a shield lead connected to the case. It has a high conversion gain up to frequencies of 100 MHz and is intended for use as r.f. amplifiers and mixer-oscillator in short-wave receivers up to 27 MHz.

RATINGS (Limiting values)¹⁾

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	32	V
Collector-emitter voltage ($Z_B/Z_E < 15$)	$-V_{CER}$	max.	32	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15	V
Collector current (d.c.)	$-I_C$	max.	10	mA
Base current (d.c.)	$ I_B $	max.	1	mA
Reverse emitter current	$-I_E$	max.	1	mA
Total power dissipation up to $T_{amb} = 45^\circ\text{C}$	P_{tot}	max.	60	mW
Storage temperature	T_{stg}		-55 to +75	$^\circ\text{C}$
Junction temperature: continuous	T_j	max.	75	$^\circ\text{C}$
incidentally	T_j	max.	90	$^\circ\text{C}$

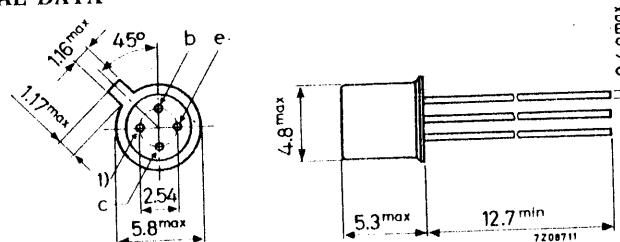
THERMAL RESISTANCE

From junction to ambient in free air	$R_{th j-a}$	=	0.75	$^\circ\text{C}/\text{mW}$
From junction to case	$R_{th j-c}$	=	0.4	$^\circ\text{C}/\text{mW}$

Dimensions in mm

MECHANICAL DATA

TO-72



1) = shield lead (connected to case)

Accessories available: 56246, 56263

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICSCollector cut-off current $I_E = 0; -V_{CB} = 0 \text{ V}$ $-I_{CBO}$ typ. 1.2 μA
≤ 8 μA $I_E = 0; -V_{CB} = 0 \text{ V}; T_J = 75^\circ\text{C}$ $-I_{CBO}$ typ. 90 μA
≤ 180 μA Base current $I_B = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ $-I_B$ typ. 7 μA
≤ 25 μA Base-emitter voltage $-I_C = 1 \text{ mA}; -V_{CE} = 6 \text{ V}$ $-V_{BE}$ typ. 270 mV
210 to 330 mVSmall signal current gain at $f = 1 \text{ kHz}$ $-I_C = 1 \text{ mA}; -V_{CE} = 6 \text{ V}$ h_{fe} typ. 150Feedback capacitance at $f = 450 \text{ kHz}$ $-I_C = 1 \text{ mA}; -V_{CE} = 6 \text{ V}$ $-C_{re}$ typ. 1.5 pFy parameters¹⁾ $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ at $f = 100 \text{ MHz}$

Input conductance

 g_{ib} typ. 15 $\text{m}\Omega^{-1}$

Input capacitance

 $-C_{ib}$ typ. 5 pF

Feedback admittance

 $|y_{rb}|$ typ. 0.45 $\text{m}\Omega^{-1}$

Phase angle of feedback admittance

 φ_{rb} typ. 250°

Transfer admittance

 $|y_{fb}|$ typ. 15 $\text{m}\Omega^{-1}$

Phase angle of transfer admittance

 φ_{fb} typ. 95°

Output conductance

 g_{ob} typ. 0.35 $\text{m}\Omega^{-1}$

Output capacitance

 C_{ob} typ. 25 pF $-I_C = 1 \text{ mA}; -V_{CE} = 6 \text{ V}$ $f = 10.7 \quad 0.45 \text{ MHz}$

Input conductance

 g_{ie} typ. 1.3 0.25 $\text{m}\Omega^{-1}$

Input capacitance

 C_{ie} typ. 65 70 pF

Feedback admittance

 $|y_{rel}|$ typ. 80 4 $\mu\Omega^{-1}$

Phase angle of feedback admittance

 φ_{re} typ. 260° 270°

Transfer admittance

 $|y_{fe}|$ typ. 34 37 $\text{m}\Omega^{-1}$

Phase angle of transfer admittance

 φ_{fe} typ. 335° 0

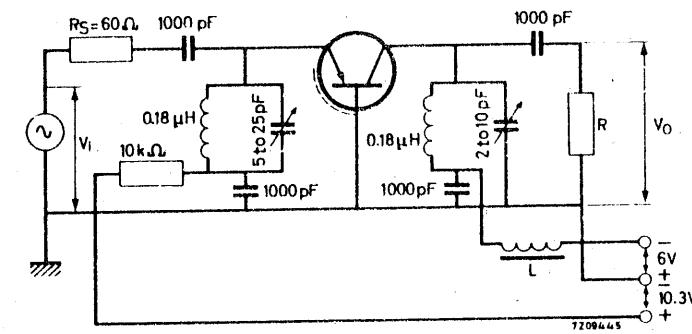
Output conductance

 g_{oe} typ. 25 1.0 $\mu\Omega^{-1}$

Output capacitance

 C_{oe} typ. 3.0 4 pF $T_{amb} = 25^\circ\text{C}$ unless otherwise specified**CHARACTERISTICS (continued)** $T_{amb} = 25^\circ\text{C}$ unless otherwise specifiedFeedback impedance at $f = 2 \text{ MHz}$ $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ $|z_{rb}|$ typ. 25 Ω Transition frequency $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ f_T typ. 75 MHzNoise figure at $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ $R_S = 60 \Omega; f = 100 \text{ MHz}$ F typ. 9.5 dB $R_S = 200 \Omega; f = 10.7 \text{ MHz}$ F typ. 3.0 dB $R_S = 500 \Omega; f = 1 \text{ MHz}$ F typ. 1.5 dBConversion noise figure at $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ $R_S = 500 \Omega; f = 1 \text{ MHz}$ F_C typ. 3 dB $R_S = 2 \text{ k}\Omega; f = 200 \text{ kHz}$ F_C typ. 4 dB $< 7 \text{ dB}$ Power gain at $f = 100 \text{ MHz}$

$$G_p = \frac{V_o^2}{V_i^2} \cdot \frac{4 R_S}{R_f} = 0.073 \frac{V_o^2}{V_i^2}$$

 G_p typ. 10 dB
typ. 13 dBTest circuit:

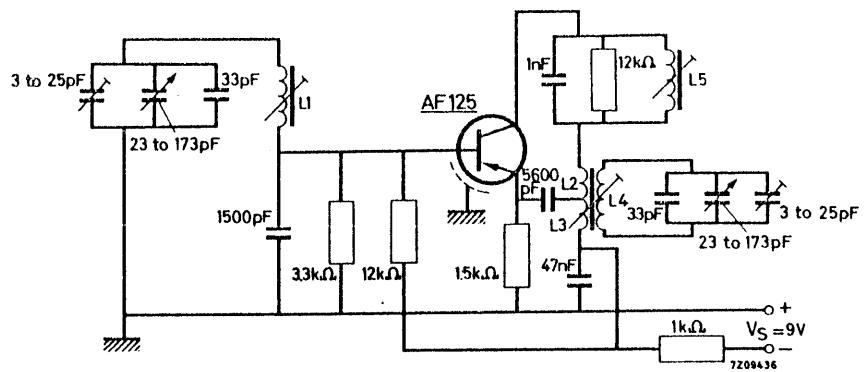
R is chosen such that the total load impedance R_f consisting of R and the tuned circuit in parallel is 3.3 kΩ.

L = ferrite bead

¹⁾ Length of leads between transistor bottom and measuring jig: 5 mm.

APPLICATION INFORMATION

1. Front-end unit of a f.m. tuner see AF124
2. Self-oscillating mixer stage (15.1 to 26.1 MHz)



L_1 = 5.5 turns enamelled Cu wire (0.25 mm), closely wound on coil former with diameter of 7 mm; inductance $0.59 \mu\text{H}$; unloaded Q-factor 100 at $f = 15 \text{ MHz}$ and 115 at $f = 26 \text{ MHz}$.

L_2 = 1.25 turns enamelled Cu wire (0.25 mm), wound in L_4 at earth side.

L_3 = 1 turn enamelled Cu wire (0.25 mm), wound in L_4 at earth side.

L_4 = 6.5 turns enamelled Cu wire (0.9 mm), closely wound on coil former with diameter of 7 mm; inductance $0.46 \mu\text{H}$; unloaded Q-factor 110 at $f = 15 \text{ MHz}$ and $f = 26 \text{ MHz}$

L_5 = Inductance $125 \mu\text{H}$; unloaded Q-factor 140.

Battery voltage

V_S = 9 V

Collector-emitter voltage

$-V_{CE}$ = 6 V

Emitter current

I_E = 1 mA

Oscillator voltage between emitter and earth

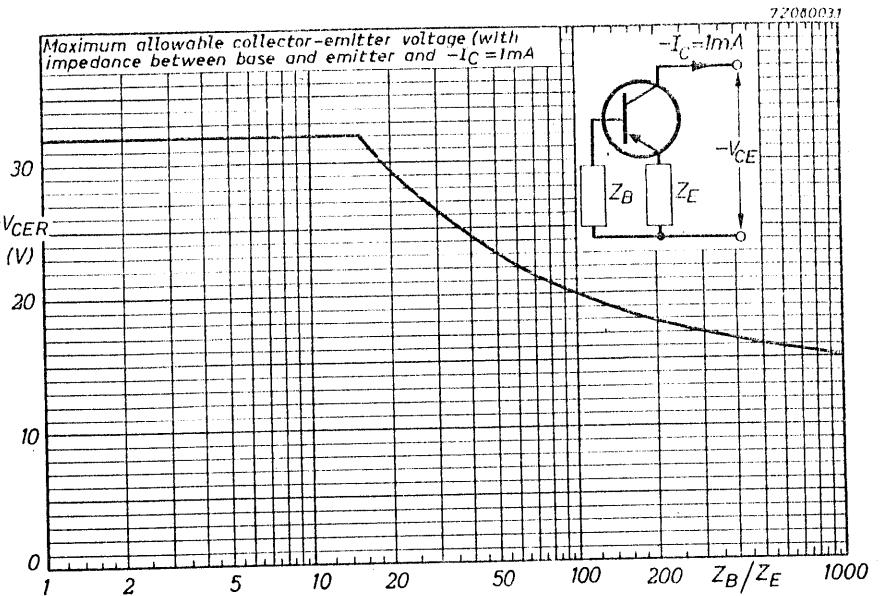
	$f = 15$	20	26 MHz
V_{osc}	typ. 0.11	0.14	0.15 V

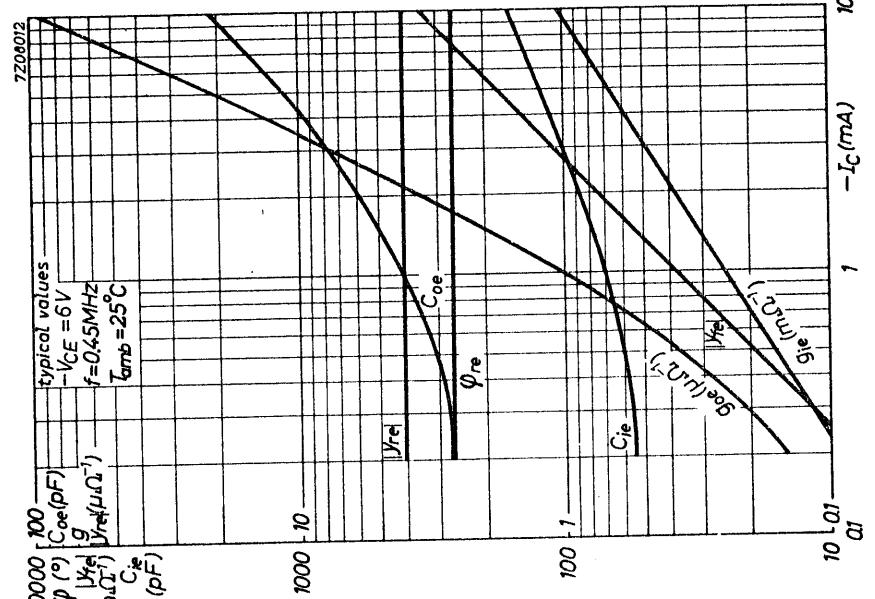
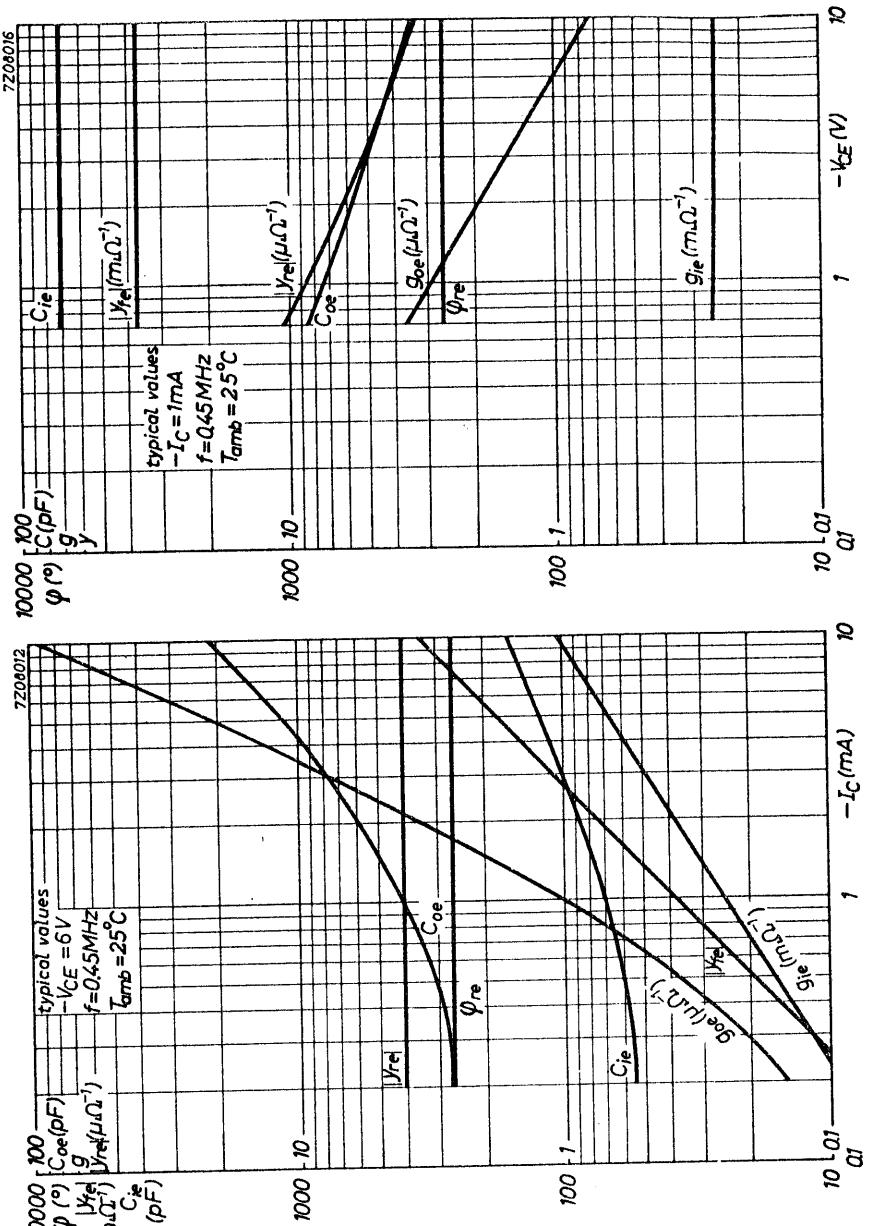
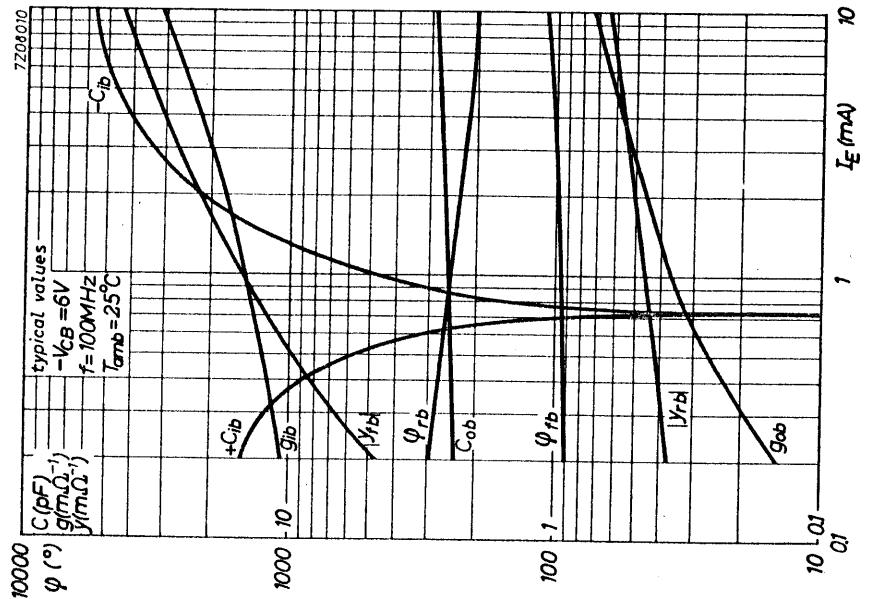
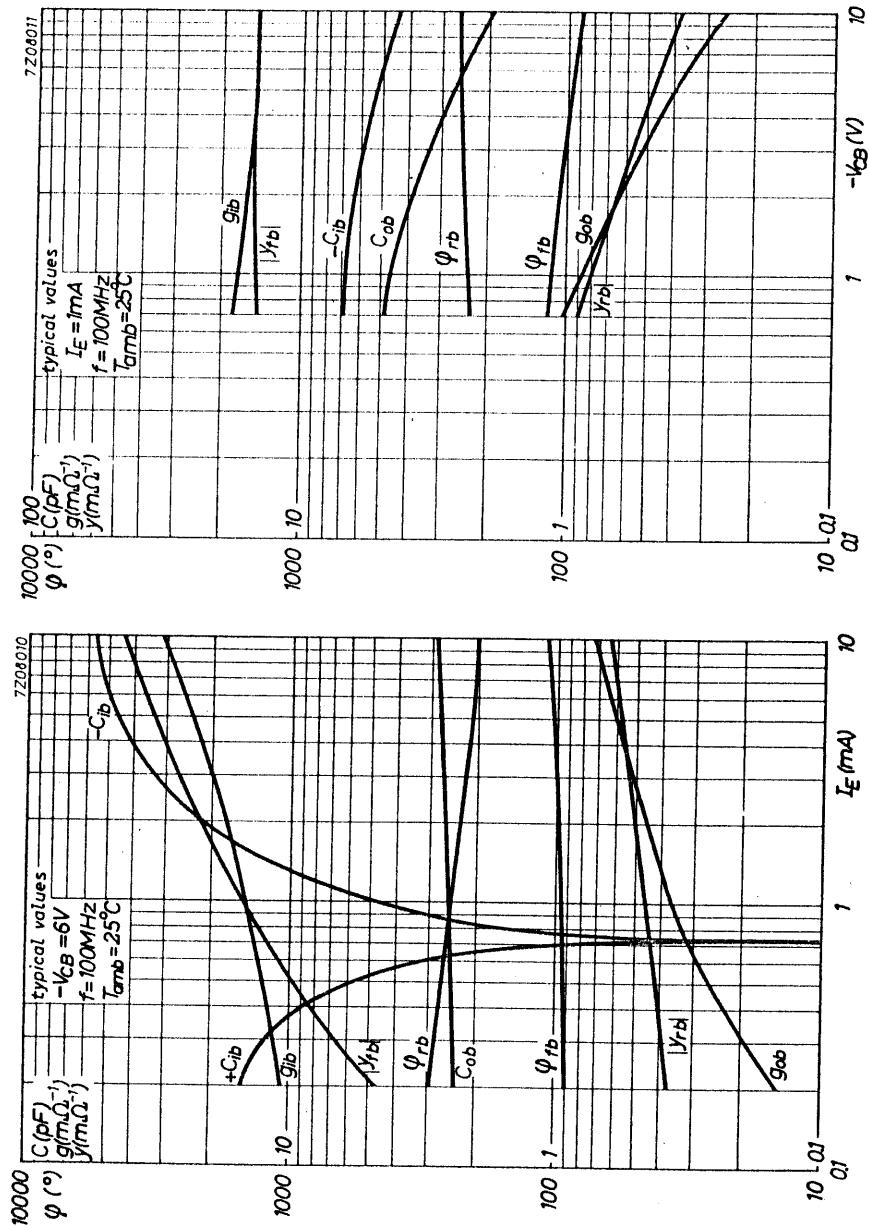
Frequency shift by a battery voltage variation from 9 to 6 V

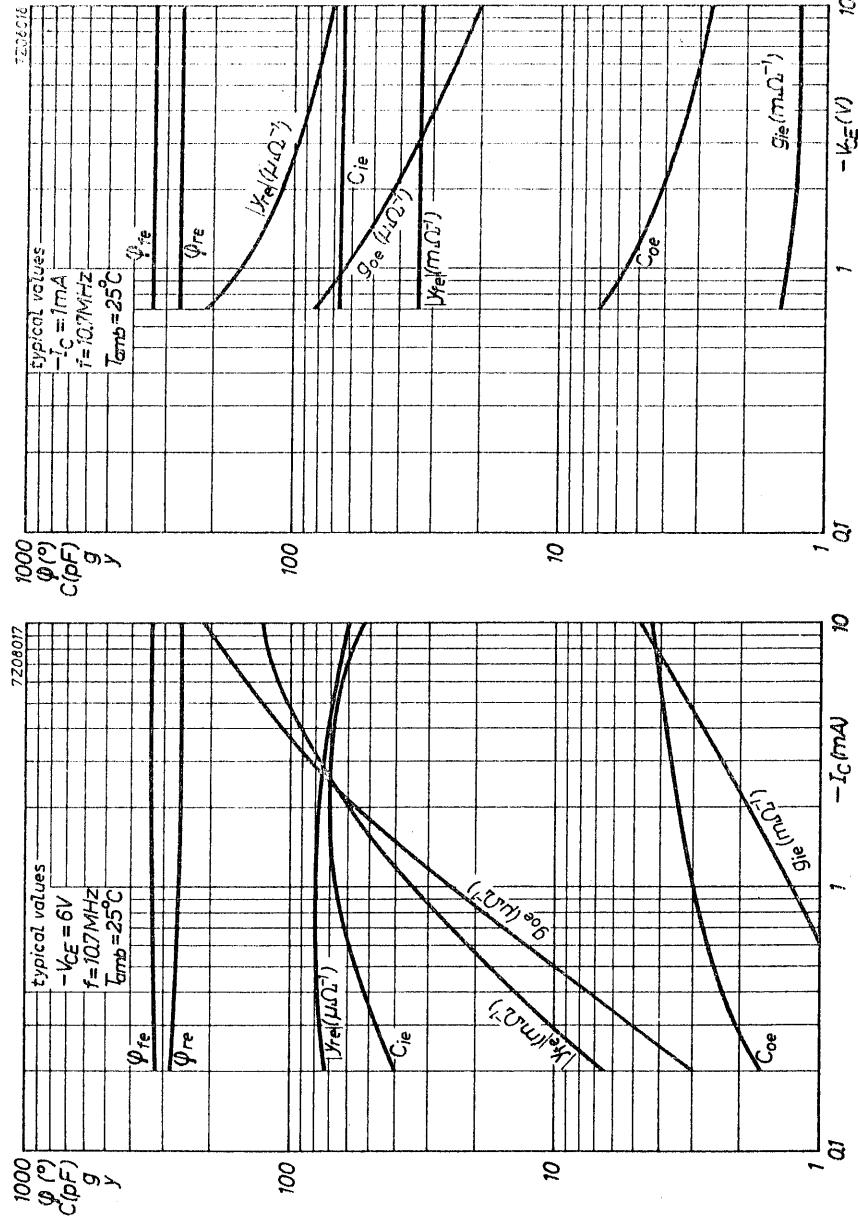
	Δf_{osc}	typ.	3	2	10 kHz

Conversion gain, defined as the ratio between the i.f. power in a $10 \text{ k}\Omega$ load (the total i.f. impedance in the collector circuit) and the available r.f. power in the aerial circuit

	$\frac{P_o}{P_i}$	typ.	26	23	20 dB

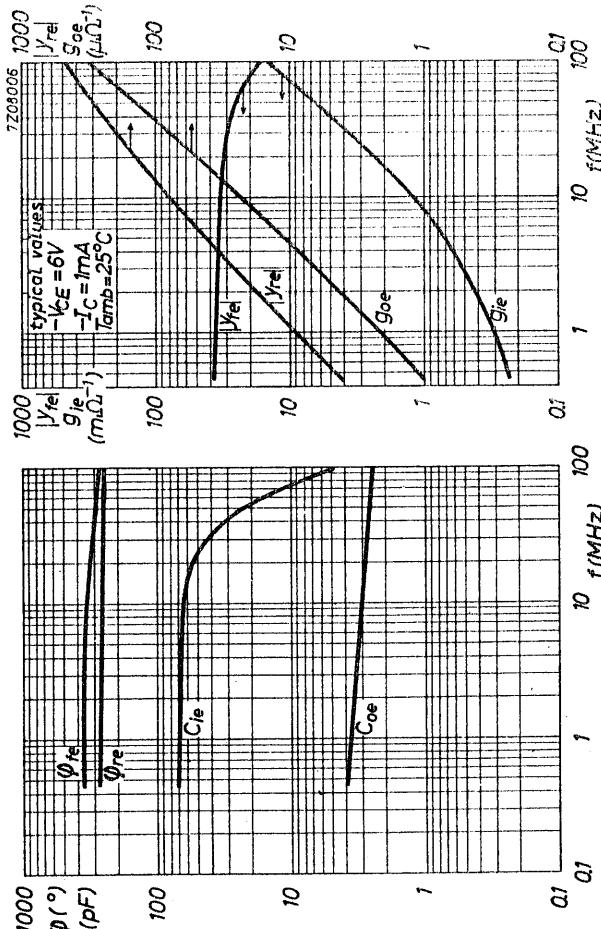






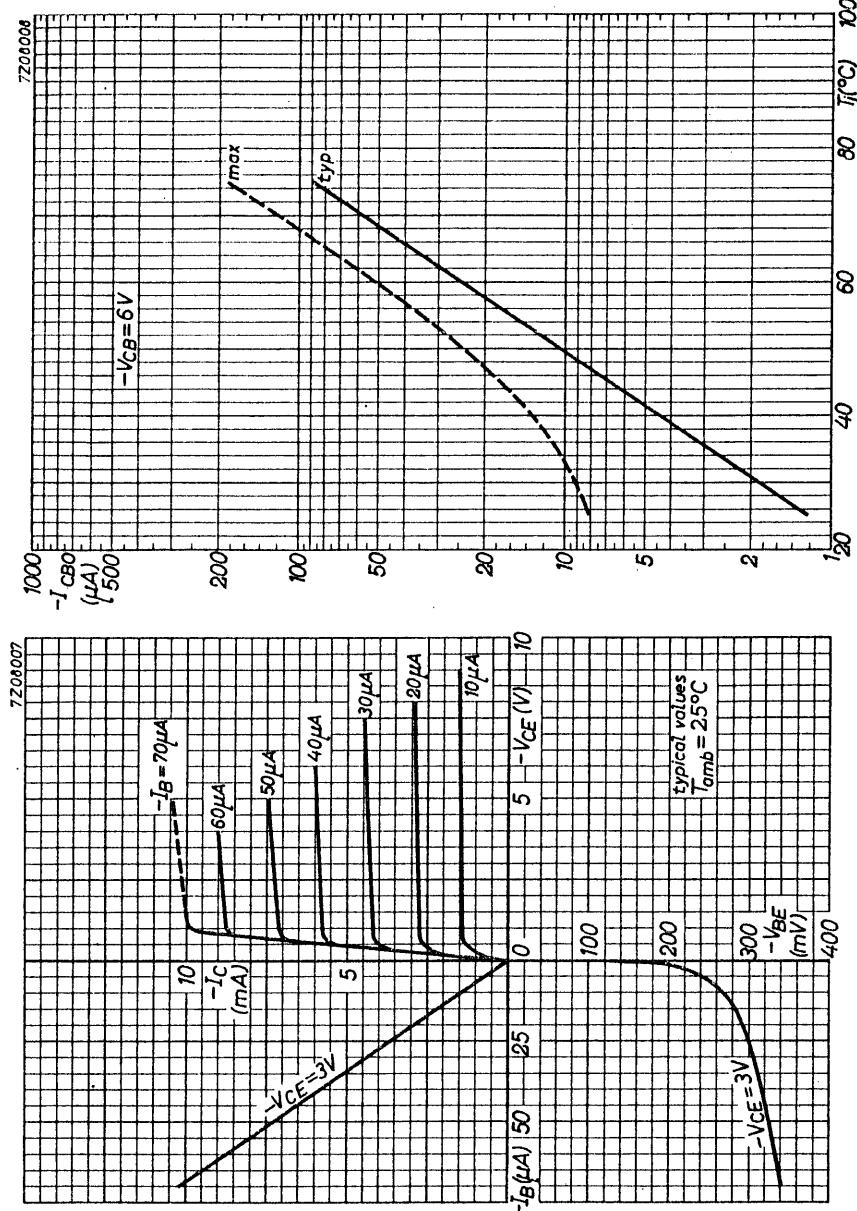
220

May 1968



221

May 1968



GERMANIUM ALLOY DIFFUSED TRANSISTOR

P-N-P transistor in a TO-72 metal envelope with a shield lead connected to the case. It has low output conductance and low collector capacitance at 10.7 MHz and low noise and good a.g.c. performance for use as i.f. amplifier in a.m. and f.m. receivers and as amplifier and mixer-oscillator in short-wave receivers up to 16 MHz.

RATINGS (Limiting values)¹⁾

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	32 V
Collector-emitter voltage ($Z_B/Z_E < 15$)	$-V_{CER}$	max.	32 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15 V
Collector current (d.c.)	$-I_C$	max.	10 mA
Base current (d.c.)	$ I_B $	max.	1 mA
Reverse emitter current	$-I_E$	max.	1 mA
Total power dissipation up to $T_{amb} = 45$ °C	P_{tot}	max.	60 mW
Storage temperature	T_{stg}		-55 to +75 °C
Junction temperature : continuous	T_j	max.	75 °C
incidentally	T_j	max.	90 °C

THERMAL RESISTANCE

From junction to ambient in free air

$$R_{th\ j-a} = 0.75 \text{ } ^\circ\text{C/mW}$$

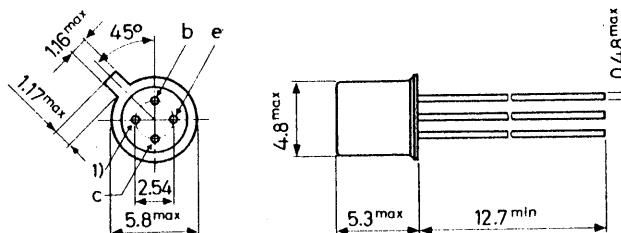
From junction to case

$$R_{th\ j-c} = 0.4 \text{ } ^\circ\text{C/mW}$$

Dimensions in mm

MECHANICAL DATA

TO-72



1) = shield lead (connected to case)

Accessories available: 56246, 56263

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS $T_{amb} = 25^{\circ}\text{C}$ unless otherwise specifiedCollector cut-off current $I_E = 0; -V_{CB} = 6 \text{ V}$

$-I_{CBO}$ typ. 1.2 μA
 $<$ 8 μA

 $I_E = 0; -V_{CB} = 6 \text{ V}; T_j = 75^{\circ}\text{C}$

$-I_{CBO}$ typ. 90 μA
 $<$ 180 μA

Base current $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$

$-I_B$ typ. 7 μA
 $<$ 25 μA

Base-emitter voltage $-I_C = 1 \text{ mA}; -V_{CE} = 6 \text{ V}$

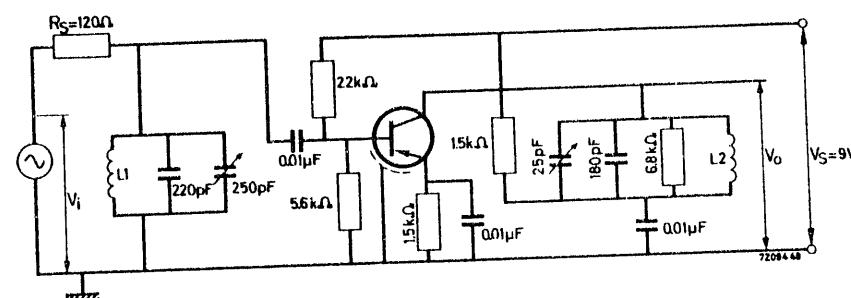
$-V_{BE}$ typ. 270 mV
 210 to 330 mV

Small signal current gain at $f = 1 \text{ kHz}$ $-I_C = 1 \text{ mA}; -V_{CE} = 6 \text{ V}$ h_{fe} typ. 150Feedback capacitance at $f = 450 \text{ kHz}$ $-I_C = 1 \text{ mA}; -V_{CE} = 6 \text{ V}$ $-C_{re}$ typ. 1.5 pFy parameters (common emitter) $-I_C = 1 \text{ mA}; -V_{CE} = 6 \text{ V}$ ¹⁾

	$f = 10.7$	0.45 MHz	
g_{ie}	typ. 1.7	0.25 $\text{m}\Omega^{-1}$	
C_{ie}	typ. 60	70 pF	
$ y_{rel} $	typ. 100	4.0 $\mu\Omega^{-1}$	
φ_{re}	typ. 260°	270°	
$ y_{fe} $	typ. 32	37 $\text{m}\Omega^{-1}$	
φ_{fe}	typ. 335°	0	
g_{oe}	typ. 40	1.0 $\mu\Omega^{-1}$	
C_{oe}	typ. 3.5	4.0 pF	

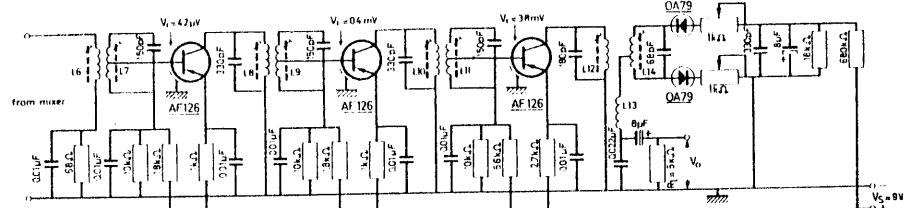
Feedback impedance at $f = 2 \text{ MHz}$ $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ $|z_{rb}|$ typ. 27 Ω **CHARACTERISTICS (continued)** $T_{amb} = 25^{\circ}\text{C}$ unless otherwise specifiedTransition frequency $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ f_T typ. 75 MHzNoise figure at $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ $R_S = 60 \Omega; f = 10.7 \text{ MHz}$ F typ. 3.0 dB $R_S = 500 \Omega; f = 1 \text{ MHz}$ F typ. 4.5 dB $R_S = 500 \Omega; f = 1 \text{ MHz}$ F typ. 1.5 dB $R_S = 500 \Omega; f = 10.7 \text{ MHz}$ F typ. 3.0 dBConversion noise figure $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ F_c typ. 3 dB $R_S = 500 \Omega; f = 1 \text{ MHz}$ F_c typ. 5 dB $R_S = 2 \text{ k}\Omega; f = 200 \text{ kHz}$ F_c typ. 4 dB $R_S = 2 \text{ k}\Omega; f = 10.7 \text{ MHz}$ F_c typ. 7 dBPower gain at $f = 10.7 \text{ MHz}$

$$G_p = \frac{V_o^2}{V_i^2} \cdot \frac{4 R_S}{R_I} = 0.1 \frac{V_o^2}{V_i^2}$$

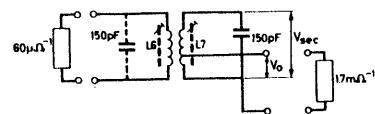
 G_p typ. 19 dB G_p typ. 25 dBTest circuit:Total collector resistance $R_I = 4.8 \text{ k}\Omega$ $L_1 = 0.5 \mu\text{H}$; unloaded Q-factor 100 $L_2 = 2.47 \mu\text{H}$; unloaded Q-factor 100¹⁾ Length of leads between transistor bottom and measuring jig : 5 mm

APPLICATION INFORMATION

I.F. amplifier for 10.7 MHz

Emitter current of each transistor $I_E = 1.0 \text{ mA}$

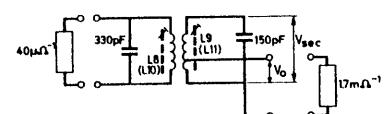
Coil data :



$$L_6 = 1.4 \mu\text{H}; Q_0 \geq 120; Q_L = 70$$

$$L_7 = 1.4 \mu\text{H}; Q_0 \geq 110; Q_L = 92$$

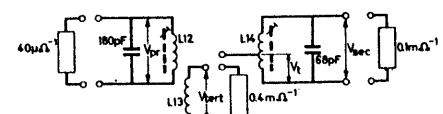
$$kQ_L = 1.25 \quad \frac{V_o}{V_{\text{sec}}} = 0.1$$



$$L_8 = L_{10} = 0.67 \mu\text{H}; Q_0 \geq 110; Q_L = 92$$

$$L_9 = L_{11} = 1.4 \mu\text{H}; Q_0 \geq 110; Q_L = 92$$

$$kQ_L = 1.25 \quad \frac{V_o}{V_{\text{sec}}} = 0.1$$

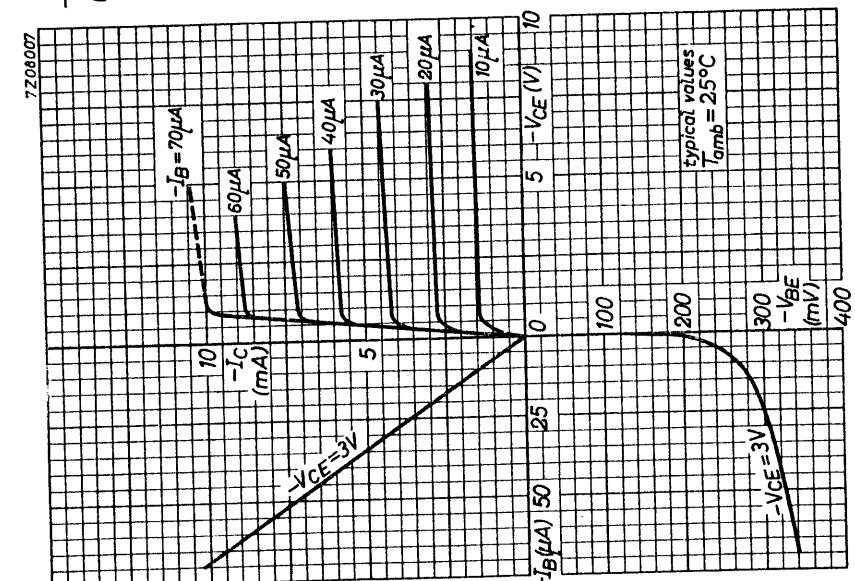
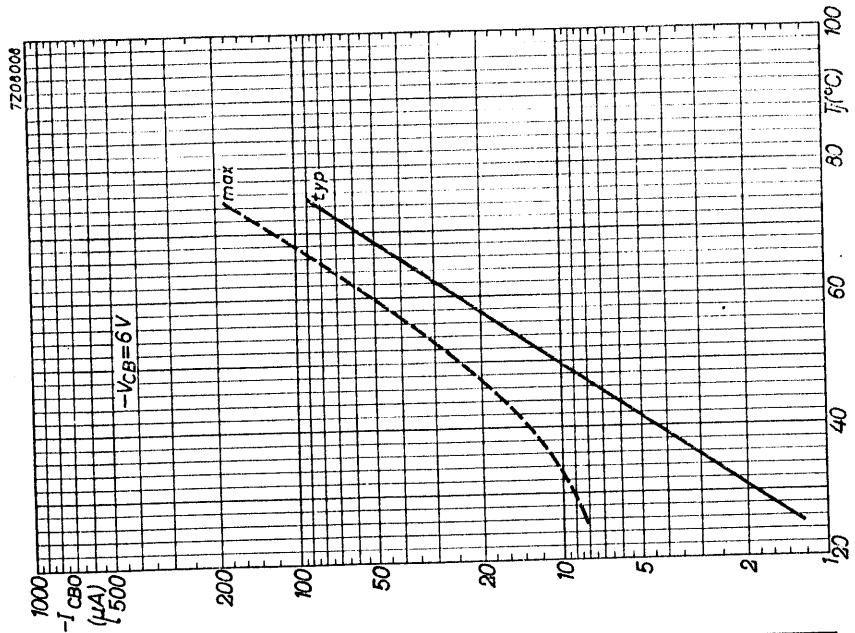


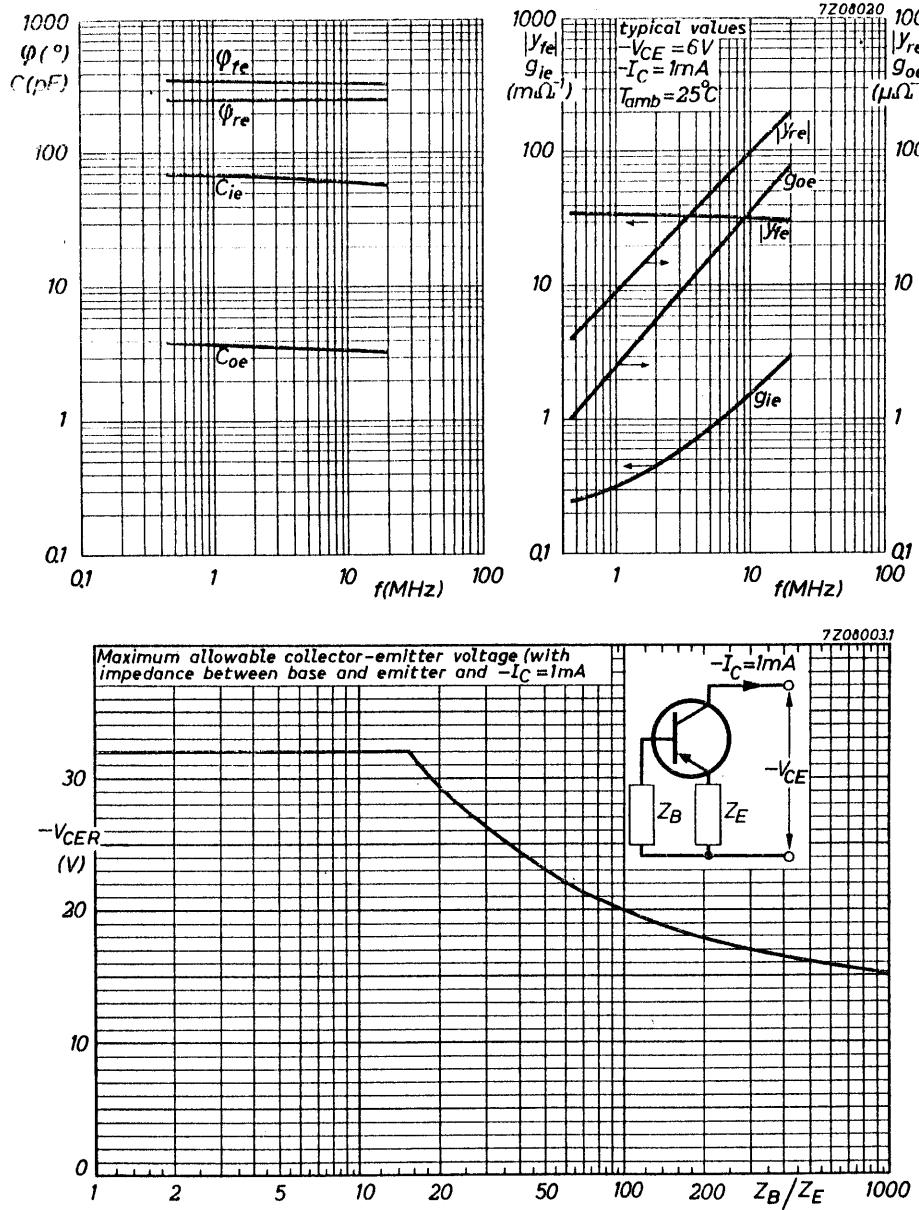
$$L_{12} = 1.2 \mu\text{H}; Q_0 = 90$$

$$L_{14} = 3.05 \mu\text{H}; Q_0 = 90 \quad (\text{bifilarly wound})$$

$$kQ_L = 0.7$$

$$\frac{V_{\text{tert}}}{V_{\text{pr}}} = 0.45; \quad \frac{V_t}{V_{\text{sec}}} = 0.5$$





GERMANIUM ALLOY DIFFUSED TRANSISTOR

P-N-Ptransistor in a TO-72 metal envelope with a shield lead connected to the case. It has a low collector capacitance, low noise and good a.g.c. performance and is intended for use as i.f. amplifier, r.f. amplifier and mixer-oscillator in a.m. receivers up to 6 MHz.

RATINGS (Limiting values)¹⁾

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	32	V
Collector-emitter voltage ($Z_B/Z_E < 15$)	$-V_{CER}$	max.	32	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15	V
Collector current (d.c.)	$-I_C$	max.	10	mA
Base current (d.c.)	$ I_B $	max.	1	mA
Reverse emitter current	$-I_E$	max.	1	mA
Total power dissipation up to $T_{amb} = 45^\circ\text{C}$	P_{tot}	max.	60	mW
Storage temperature	T_{stg}	-55 to +75	$^\circ\text{C}$	
Junction temperature : continuous	T_j	max.	75	$^\circ\text{C}$
incidentally	T_j	max.	90	$^\circ\text{C}$

THERMAL RESISTANCE

From junction to ambient in free air

$$R_{th j-a} = 0.75 \text{ } ^\circ\text{C/mW}$$

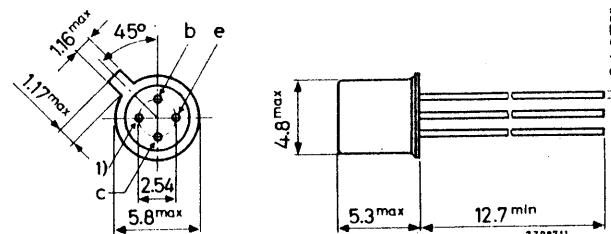
From junction to case

$$R_{th j-c} = 0.4 \text{ } ^\circ\text{C/mW}$$

Dimensions in mm

MECHANICAL DATA

TO-72



1) = shield lead (connected to case)

Accessories available: 56246, 56263

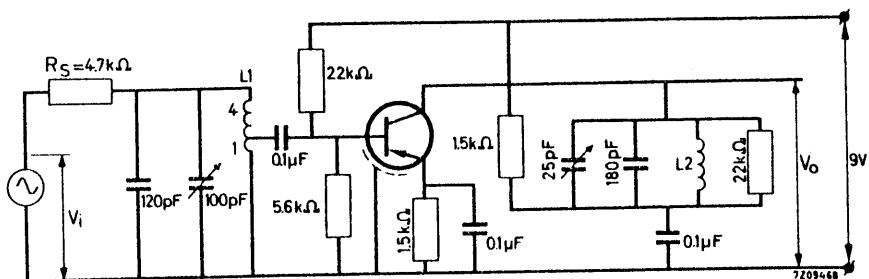
¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS $T_{amb} = 25^{\circ}\text{C}$ unless otherwise specifiedCollector cut-off current $I_E = 0; -V_{CB} = 6 \text{ V}$ $-I_{CBO}$ typ. 1.2 μA
8 μA $I_E = 0; -V_{CB} = 6 \text{ V}; T_j = 75^{\circ}\text{C}$ $-I_{CBO}$ typ. 90 μA
180 μA Base current $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ $-I_B$ typ. 7 μA
25 μA Base-emitter voltage $-I_C = 1 \text{ mA}; -V_{CE} = 6 \text{ V}$ $-V_{BE}$ typ. 270 mV
210 to 330 mVSmall signal current gain at $f = 1 \text{ kHz}$ $-I_C = 1 \text{ mA}; -V_{CE} = 6 \text{ V}$ h_{fe} typ. 150Feedback capacitance at $f = 450 \text{ kHz}$ $-I_C = 1 \text{ mA}; -V_{CE} = 6 \text{ V}$ $-C_{re}$ typ. 1.5 pFy parameters at $f = 0.45 \text{ MHz}$ (common emitter) $-I_C = 1 \text{ mA}; -V_{CE} = 6 \text{ V}$ ¹⁾

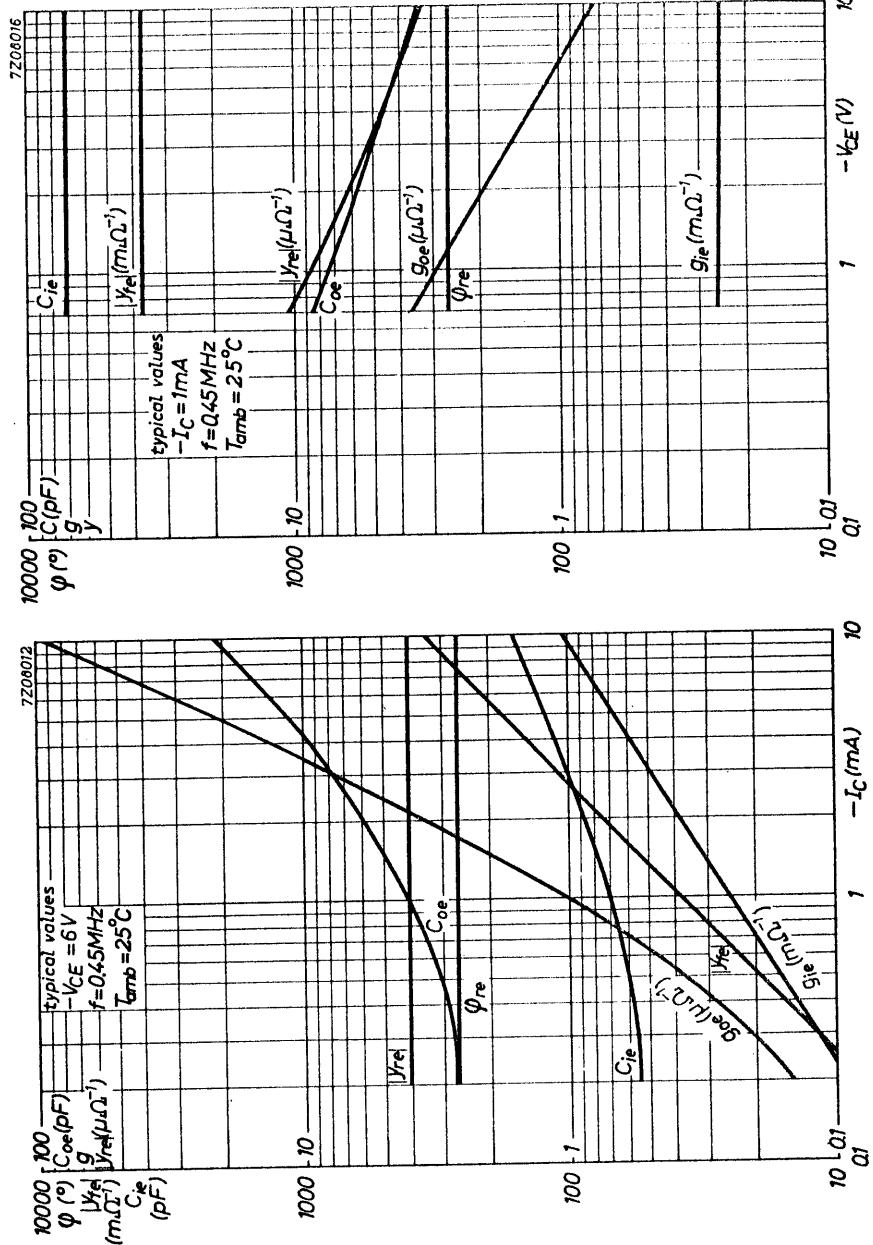
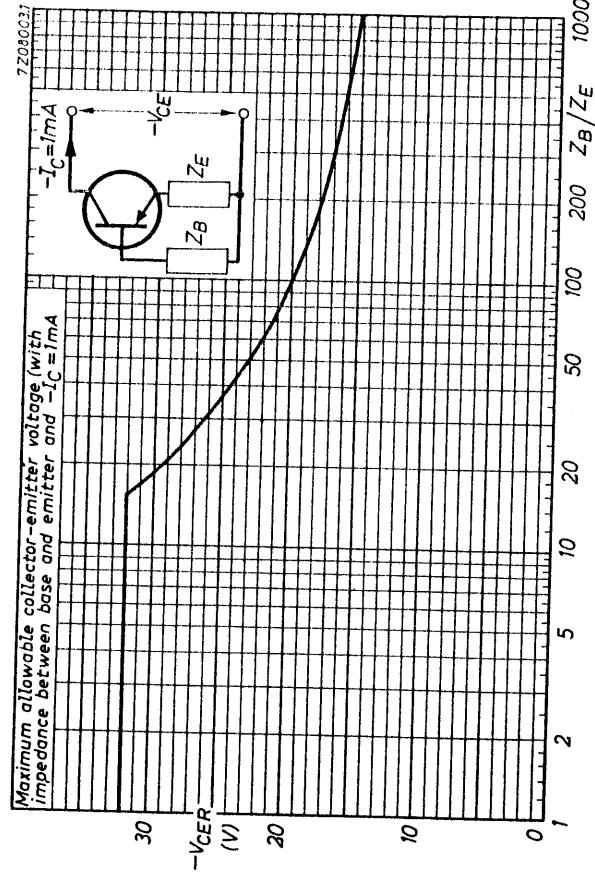
Input conductance	g_{ie}	typ. 0.25 $\text{m}\Omega^{-1}$
Input capacitance	C_{ie}	typ. 70 pF
Feedback admittance	$ y_{re} $	typ. 4.0 $\mu\Omega^{-1}$
Phase angle of feedback admittance	φ_{re}	typ. 270°
Transfer admittance	$ y_{fe} $	typ. 37 $\text{m}\Omega^{-1}$
Phase angle of transfer admittance	φ_{fe}	typ. 0
Output conductance	g_{oe}	typ. 1.0 $\mu\Omega^{-1}$
Output capacitance	C_{oe}	typ. 4.0 pF

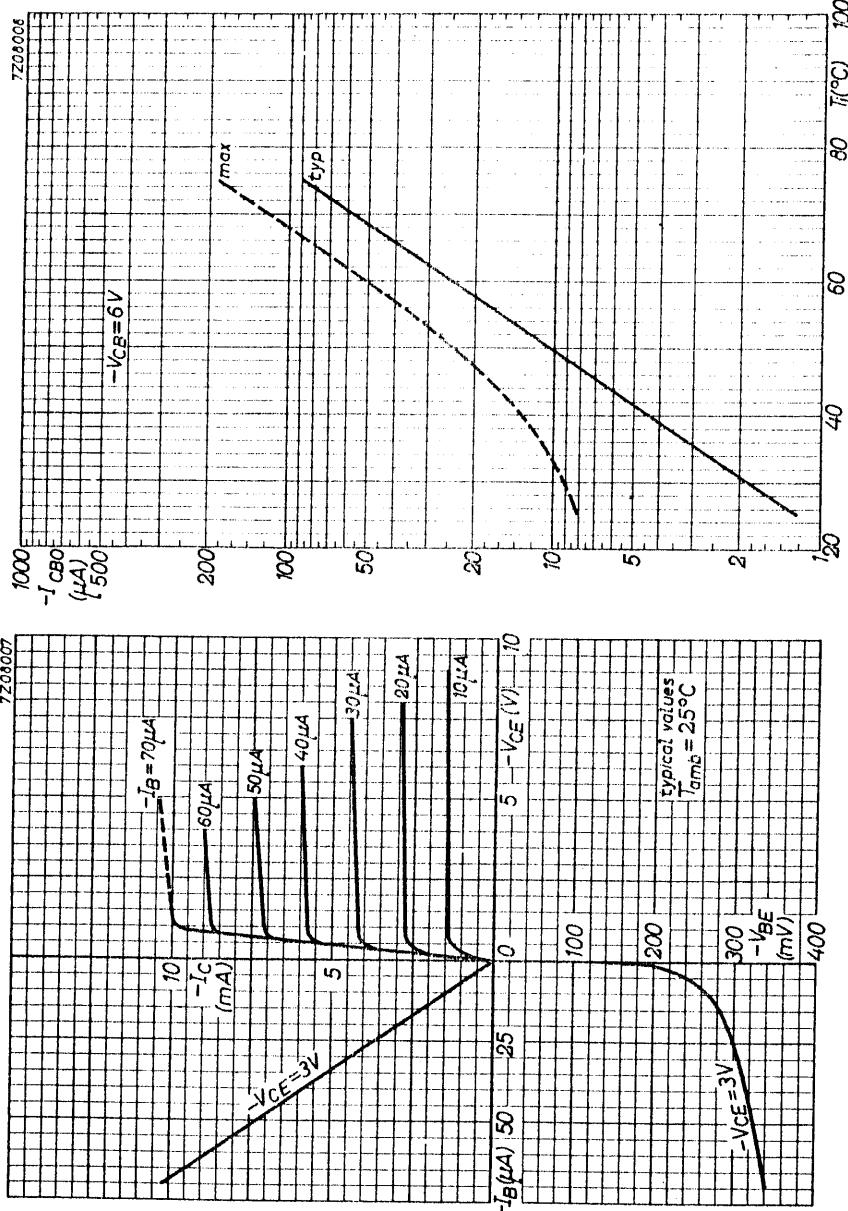
Feedback impedance at $f = 2 \text{ MHz}$ $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ $|z_{rb}|$ typ. 35 Ω ¹⁾ Length of leads between transistor bottom and measuring jig : 5 mm**CHARACTERISTICS (continued)** $T_{amb} = 25^{\circ}\text{C}$ unless otherwise specifiedTransition frequency $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ f_T typ. 75 MHzNoise figure at $f = 1.0 \text{ MHz}$ $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}; R_S = 500 \Omega$ F typ. 1.5 dB
< 3 dBConversion noise figure $I_E = 1 \text{ mA}; -V_{CB} = 6 \text{ V}$ F_c typ. 3 dB
< 5 dB $R_S = 500 \Omega; f = 1 \text{ MHz}$ F_c typ. 4 dB
< 7 dB $R_S = 2 \text{k}\Omega; f = 200 \text{ kHz}$ Power gain at $f = 0.45 \text{ MHz}$

$$G_p = \frac{V_o^2}{V_i^2} \cdot \frac{4 R_S}{R_L} = 0.94 \frac{V_o^2}{V_i^2}$$

 G_p > 40 dB
typ. 42 dBTest circuit :

Total collector resistance $R_\ell = 20 \text{ k}\Omega$
 $L_1 = 625 \mu\text{H}$; unloaded Q-factor 140; tap at 0.2
 $L_2 = 625 \mu\text{H}$; unloaded Q-factor 140





U.H.F. GERMANIUM MESA TRANSISTOR

P-N-P transistor in a TO-72 metal envelope, primarily intended for use in pre-amplifier, mixer or oscillator circuits up to frequencies of 860 MHz.

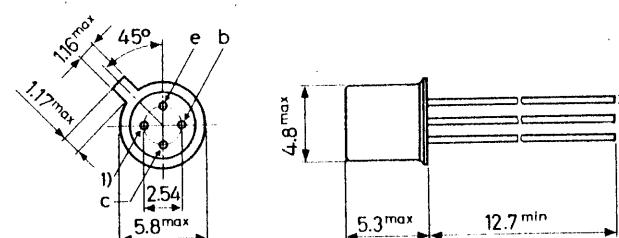
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	$-V_{CBO}$	max. 20 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max. 15 V
Collector current (d.c.)	$-I_C$	max. 10 mA
Total power dissipation up to $T_{amb} = 45^{\circ}\text{C}$	P_{tot}	max. 60 mW
Junction temperature	T_j	max. 90 °C
Transition frequency	f_T	typ. 550 MHz
$-I_C = 1.5 \text{ mA}; -V_{CE} = 12 \text{ V}$	GUM	typ. 11.5 dB
Max. unilateralised power gain		
$I_E = 1.5 \text{ mA}; -V_{CB} = 12 \text{ V}; f = 800 \text{ MHz}$	F	typ. 7 dB
Noise figure		
$I_E = 1.5 \text{ mA}; -V_{CB} = 12 \text{ V}; f = 800 \text{ MHz}; R_S = 60 \Omega$		

MECHANICAL DATA

TO-72

Dimensions in mm



1) = shield lead (connected to case)

Accessories available: 56246, 56263

RATINGS (Limiting values)¹⁾Voltages

Collector-base voltage (open emitter)	$-V_{CBO}$	max.	20 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	15 V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	0.3 V

Currents

Collector current (d.c.)	$-I_C$	max.	10 mA
Collector current (peak value)	$-I_{CM}$	max.	10 mA

Power dissipation

Total power dissipation up to $T_{amb} = 45^\circ\text{C}$	P_{tot}	max.	60 mW
--	-----------	------	-------

Temperatures

Storage temperature	T_{stg}	-30 to +75	$^\circ\text{C}$
Junction temperature	T_j	max.	90 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th j-a}$	=	0.75 $^\circ\text{C}/\text{mW}$
From junction to case	$R_{th j-c}$	=	0.40 $^\circ\text{C}/\text{mW}$

CHARACTERISTICS $T_j = 25^\circ\text{C}$ unless otherwise specifiedCollector cut-off current

$I_E = 0; -V_{CB} = 20 \text{ V}$	$-I_{CBO}$	typ.	0.5 μA
$I_B = 0; -V_{CE} = 15 \text{ V}$	$-I_{CEO}$	<	8 μA

Emitter cut-off current

$I_C = 0; -V_{EB} = 0.3 \text{ V}$	$-I_{EBO}$	typ.	2 μA
$I_B = 0; -V_{CB} = 12 \text{ V}$	$-I_B$	<	100 μA

Base current

$I_E = 1.5 \text{ mA}; -V_{CB} = 12 \text{ V}$	$-I_B$	typ.	30 μA
$I_E = 2 \text{ mA}; -V_{CB} = 6 \text{ V}$	$-I_B$	typ.	36 μA
$I_E = 5 \text{ mA}; -V_{CB} = 6 \text{ V}$	$-I_B$	typ.	66 μA

Emitter-base voltage

$I_E = 1.5 \text{ mA}; -V_{CB} = 12 \text{ V}$	V_{EB}	typ.	380 mV
$I_E = 2 \text{ mA}; -V_{CB} = 6 \text{ V}$	V_{EB}	typ.	320 to 430 mV
$I_E = 5 \text{ mA}; -V_{CB} = 6 \text{ V}$	V_{EB}	typ.	405 mV

Transition frequency

$-I_C = 1.5 \text{ mA}; -V_{CE} = 12 \text{ V}$	f_T	typ.	550 MHz
---	-------	------	---------

Reverse transfer time constant

$I_E = 1.5 \text{ mA}; -V_{CB} = 12 \text{ V}; f = 2.5 \text{ MHz}$	$r_{bb'} \cdot C_{bc}$	typ.	3 ps
---	------------------------	------	------

Feedback capacitance at $f = 450 \text{ kHz}$

$-I_C = 1.5 \text{ mA}; -V_{CE} = 12 \text{ V}$	$-C_{re}$	typ.	250 fF ¹⁾
---	-----------	------	----------------------

Noise figure at $R_S = 60 \Omega$

$I_E = 1.5 \text{ mA}; -V_{CB} = 12 \text{ V}; f = 800 \text{ MHz}$	F	typ.	7 dB
$f = 860 \text{ MHz}$	F	<	8.2 dB

¹⁾ 1 fF = 1 femtofarad = 10^{-15} F

¹⁾) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS (continued)y parameters at f = 800 MHz¹⁾

$$I_E = 1.5 \text{ mA}; -V_{CB} = 12 \text{ V}$$

Input conductance	g_{ib}	typ.	$7 \text{ m}\Omega^{-1}$
Input capacitance	$-C_{ib}$	typ.	2.2 pF
Input susceptance	$-\omega C_{ib}$	typ.	$11 \text{ m}\Omega^{-1}$
Feedback admittance	$ y_{rb} $	typ.	$0.4 \text{ m}\Omega^{-1}$
Phase angle of feedback admittance	φ_{rb}	typ.	240°
Transfer admittance	$ y_{fb} $	typ.	$14 \text{ m}\Omega^{-1}$
Phase angle of transfer admittance	φ_{fb}	typ.	35°
Output conductance	g_{ob}	typ.	$0.5 \text{ m}\Omega^{-1}$
Output capacitance	C_{ob}	typ.	1.5 pF

y parameters at f = 200 MHz¹⁾

$$I_E = 1.5 \text{ mA}; -V_{CB} = 12 \text{ V}$$

Input conductance	g_{ib}	typ.	$28 \text{ m}\Omega^{-1}$
Input capacitance	$-C_{ib}$	typ.	19 pF
Input susceptance	$-\omega C_{ib}$	typ.	$24 \text{ m}\Omega^{-1}$
Feedback admittance	$ y_{rb} $	typ.	$0.17 \text{ m}\Omega^{-1}$
Phase angle of feedback admittance	φ_{rb}	typ.	250°
Transfer admittance	$ y_{fb} $	typ.	$37 \text{ m}\Omega^{-1}$
Phase angle of transfer admittance	φ_{fb}	typ.	126°
Output conductance	g_{ob}	typ.	$90 \mu\Omega^{-1}$
Output capacitance	C_{ob}	typ.	1.5 pF

Maximum unilateralised power gain

$$G_{UM} = \frac{|y_{fb}|^2}{4 g_{ib} g_{ob}}$$

$$I_E = 1.5 \text{ mA}; -V_{CB} = 12 \text{ V}; f = 800 \text{ MHz}$$

$$G_{UM} \quad \text{typ. } 11.5 \text{ dB}$$

¹⁾ Measured with a lead length of 5 mm.

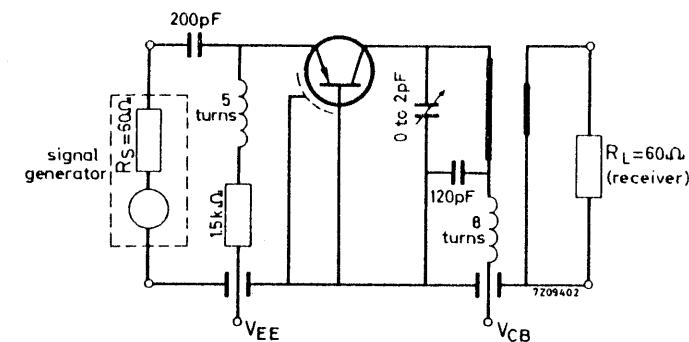
$T_j = 25^\circ\text{C}$ unless otherwise specified

CHARACTERISTICS (continued)

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

Transducer gain

Basic circuit for measuring the transducer gain G_{tr} .



Total effective collector resistance $R_C = 1.4 \text{ k}\Omega$

$$G_{tr} = \frac{\text{output power in load } R_L}{\text{available power from source } R_S}$$

$$I_E = 1.5 \text{ mA}; -V_{CB} = 12 \text{ V}$$

$$f = 800 \text{ MHz} \quad G_{tr} \quad > 9 \text{ dB}$$

$$f = 860 \text{ MHz} \quad G_{tr} \quad \text{typ. } 11 \text{ dB}$$

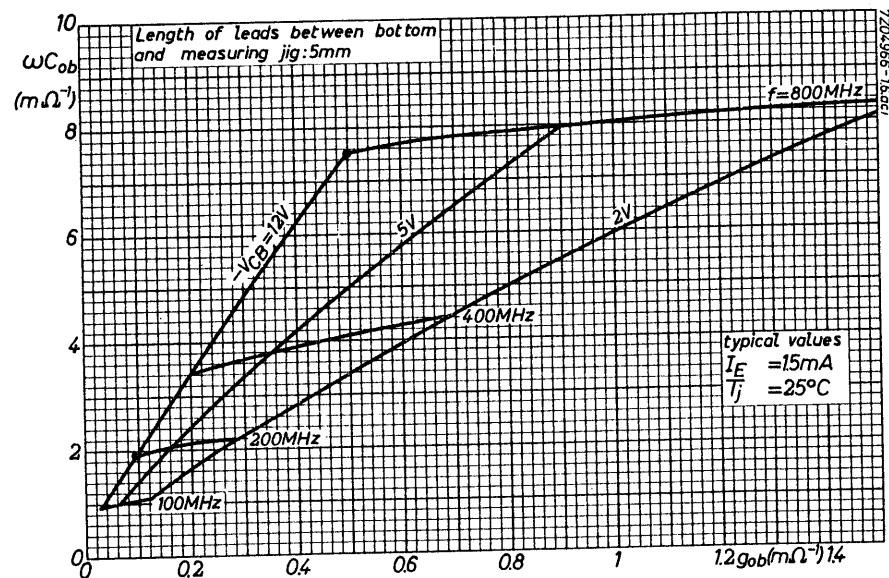
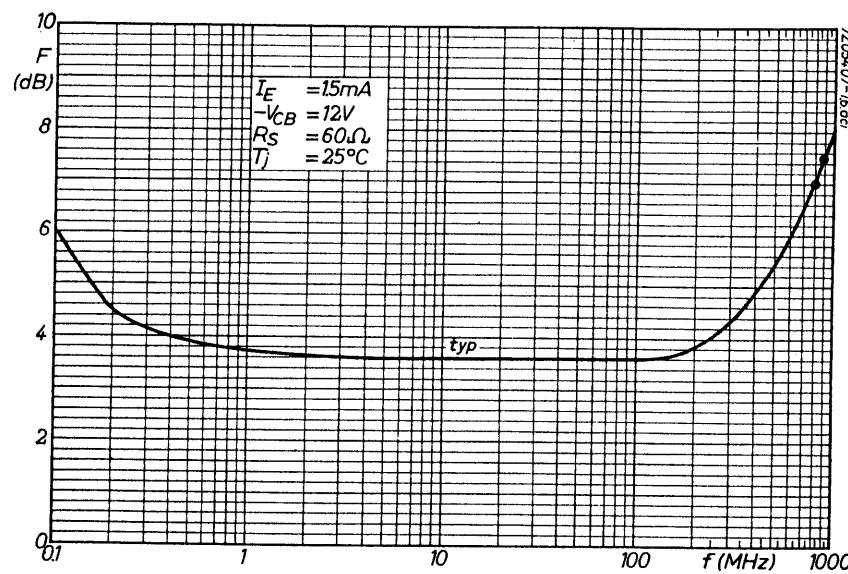
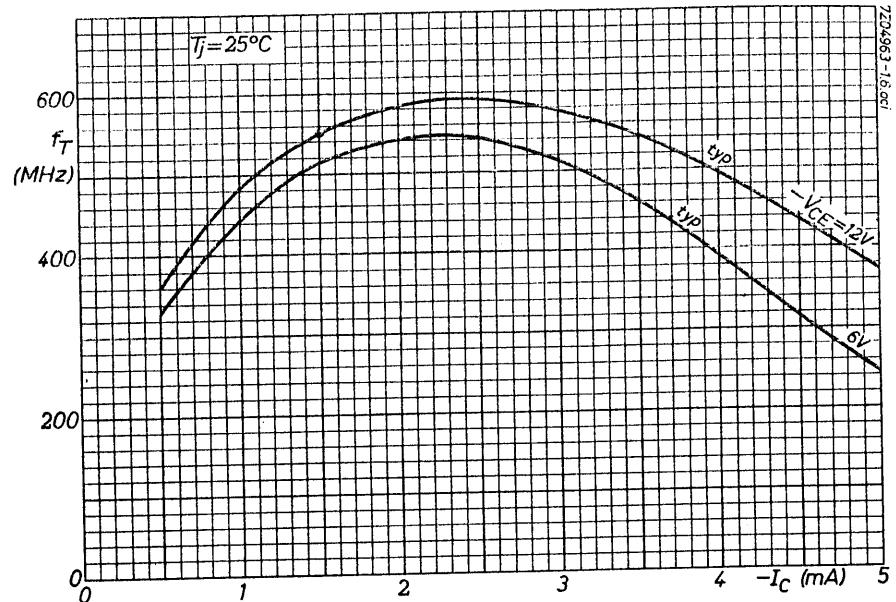
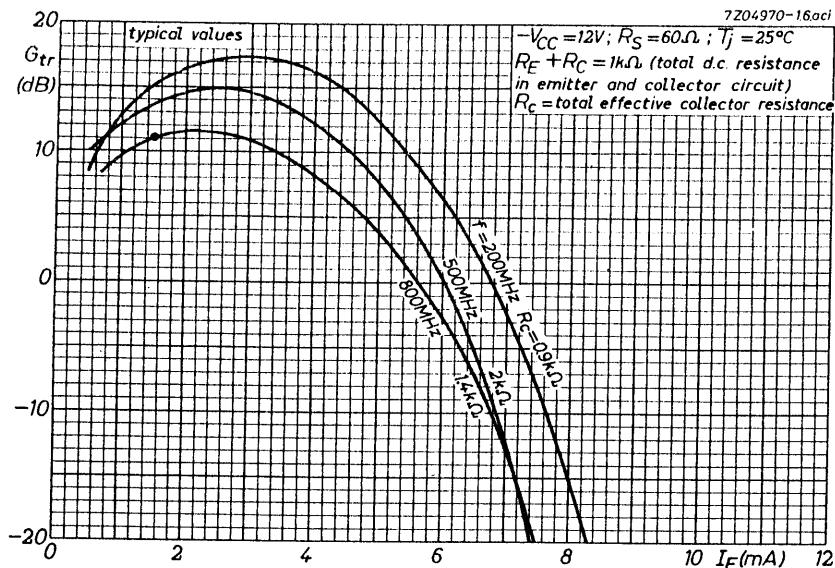
$$f = 860 \text{ MHz} \quad G_{tr} \quad > 7.5 \text{ dB}$$

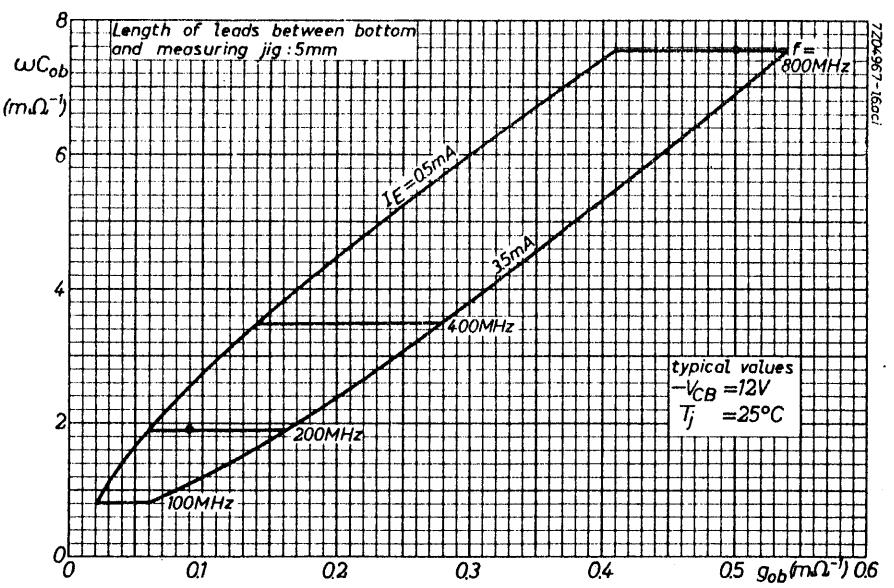
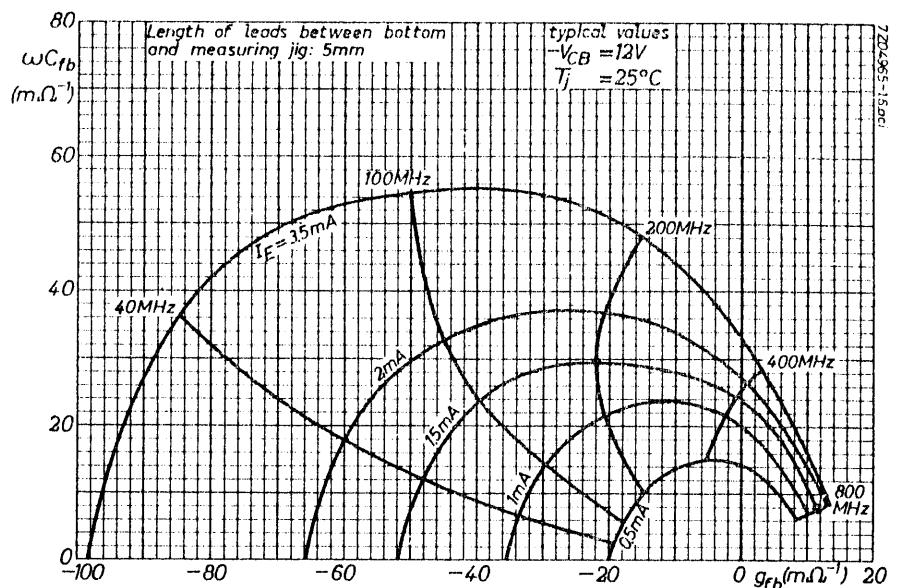
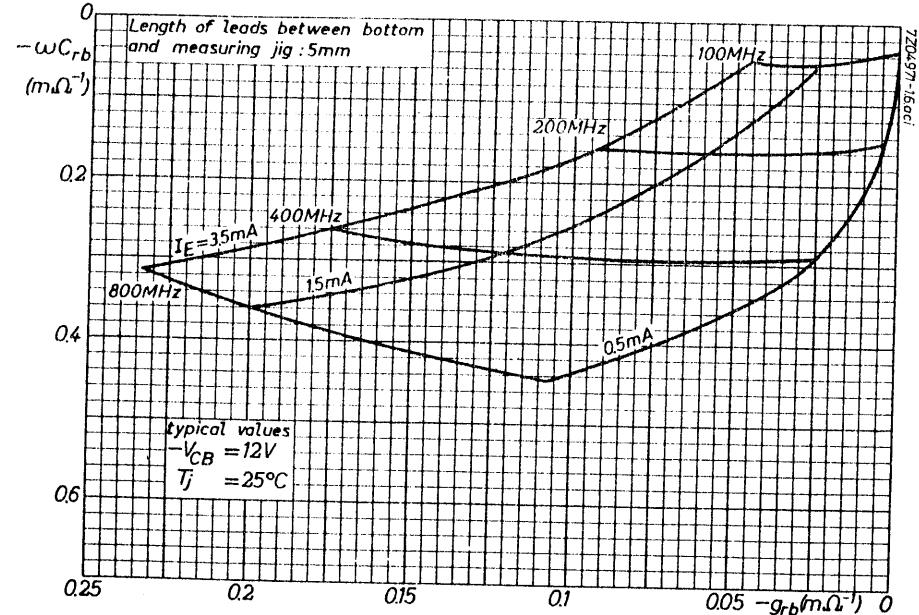
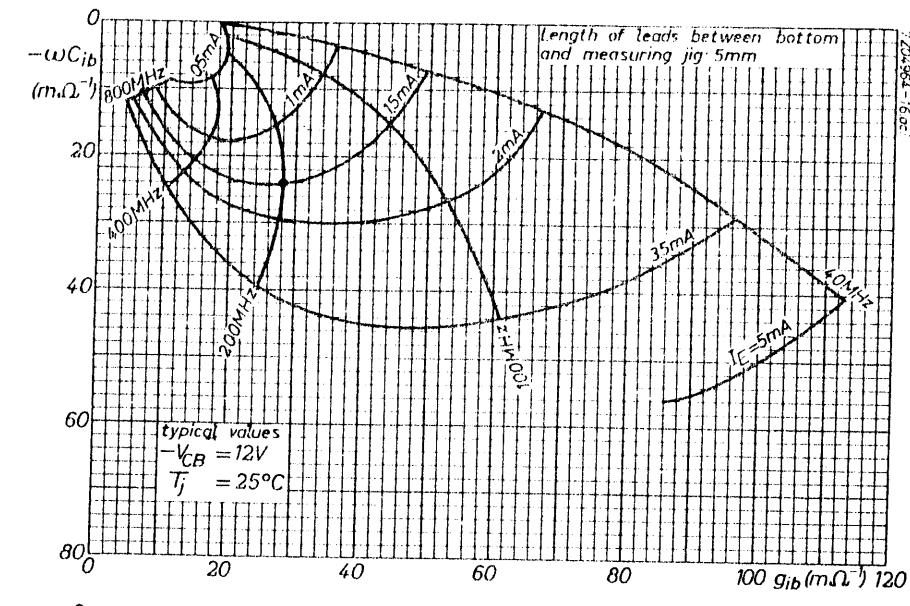
$$f = 860 \text{ MHz} \quad G_{tr} \quad \text{typ. } 10 \text{ dB}$$

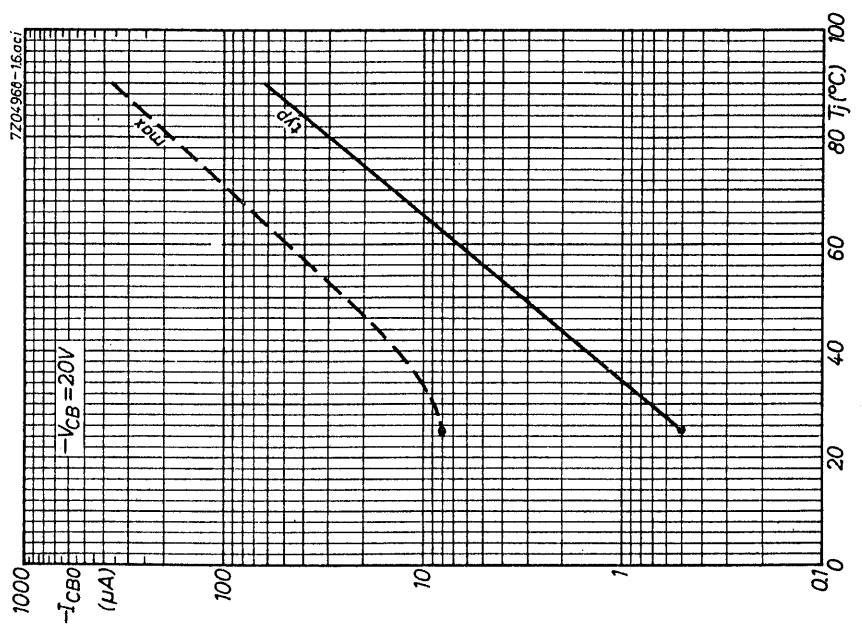
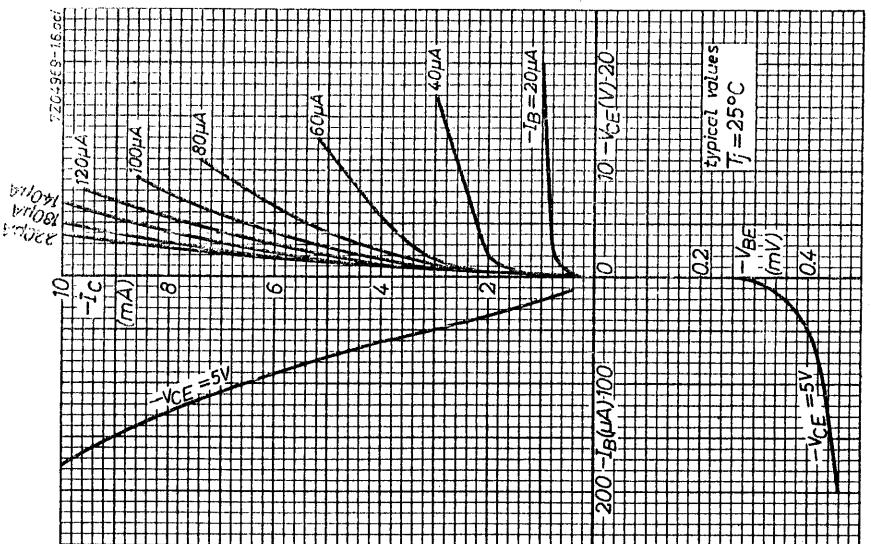
Reverse transducer gain

$$I_E = 1.5 \text{ mA}; -V_{CB} = 12 \text{ V}; f = 800 \text{ MHz}$$

The reverse transducer gain is measured in the above circuit, with the signal generator and the load (receiver) interchanged.







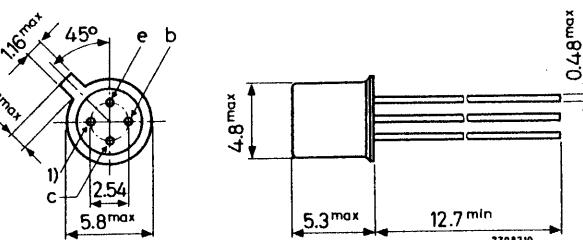
U.H.F GERMANIUM MESA TRANSISTOR

p-N-P transistor in a TO-72 metal envelope, primarily intended for use in pre-amplifier, mixer or oscillator circuits up to frequencies of 890 MHz.

QUICK REFERENCE DATA		
Collector-base voltage (open emitter)	$-V_{CBO}$	max. 20 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max. 15 V
Collector current (d.c.)	$-I_C$	max. 15 mA
Total power dissipation up to $T_{amb} = 45^\circ C$	P_{tot}	max. 60 mW
Junction temperature	T_j	max. 90 $^\circ C$
Transition frequency	f_T	typ. 650 MHz
$-I_C = 2 \text{ mA}; -V_{CE} = 10 \text{ V}$	GUM	typ. 17 dB
Max. unilateralised power gain	F	typ. 3 dB
$I_E = 2 \text{ mA}; -V_{CB} = 10 \text{ V}; f = 800 \text{ MHz}$	F	typ. 5 dB
Noise figure		
$I_E = 2 \text{ mA}; -V_{CB} = 10 \text{ V}$		
$G_S = 16.7 \text{ m}\Omega^{-1}; B_S = 0$		
$f = 200 \text{ MHz}$		
$f = 800 \text{ MHz}$		

MECHANICAL DATA

TO-72



1) = shield lead (connected to case)

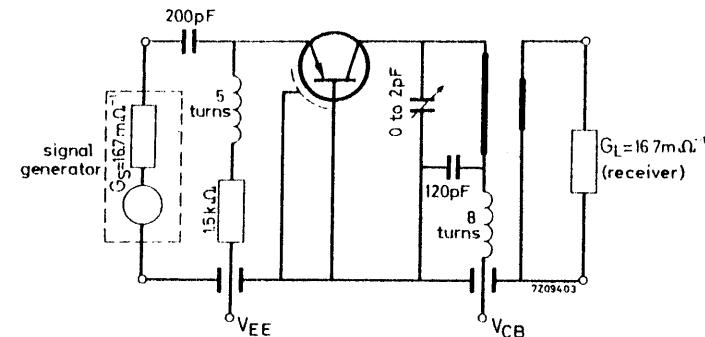
Accessories available: 56246, 56263

RATINGS (Limiting values) ¹⁾VoltagesCollector-base voltage (open emitter) $-V_{CBO}$ max. 20 VCollector-emitter voltage (open base) $-V_{CEO}$ max. 15 VEmitter-base voltage (open collector) $-V_{EBO}$ max. 0.3 VCurrentsCollector current (d.c.) $-I_C$ max. 15 mACollector current (peak value) $-I_{CM}$ max. 15 mAPower dissipationTotal power dissipation up to $T_{amb} = 45^\circ\text{C}$ P_{tot} max. 60 mWTemperaturesStorage temperature T_{stg} $-30 \text{ to } +75^\circ\text{C}$ Junction temperature T_j max. 90 $^\circ\text{C}$ **THERMAL RESISTANCE**From junction to ambient in free air $R_{th j-a}$ = 0.75 $^\circ\text{C}/\text{mW}$ From junction to case $R_{th j-c}$ = 0.40 $^\circ\text{C}/\text{mW}$ **CHARACTERISTICS** $T_j = 25^\circ\text{C}$ unless otherwise specifiedCollector cut-off current $V_{EB} = 0; -V_{CB} = 20 \text{ V}$ $-I_{CBS}$ typ. 0.5 μA $I_B = 0; -V_{CE} = 15 \text{ V}$ $-I_{CEO}$ < 500 μA Emitter cut-off current $I_C = 0; -V_{EB} = 0.3 \text{ V}$ $-I_{EBO}$ < 100 μA Base current $I_E = 2 \text{ mA}; -V_{CB} = 10 \text{ V}$ $-I_B$ typ. 60 μA $I_E = 5 \text{ mA}; -V_{CB} = 5 \text{ V}$ $-I_B$ typ. 167 μA $I_E = 10 \text{ mA}; -V_{CB} = 2 \text{ V}$ $-I_B$ < 1 mAEmitter-base voltage $I_E = 2 \text{ mA}; -V_{CB} = 10 \text{ V}$ V_{EB} typ. 350 mV $I_E = 5 \text{ mA}; -V_{CB} = 5 \text{ V}$ V_{EB} typ. 400 mVTransition frequency $-I_C = 2 \text{ mA}; -V_{CE} = 10 \text{ V}$ f_T typ. 650 MHzFeedback capacitance at $f = 1 \text{ MHz}$ $-I_C = 2 \text{ mA}; -V_{CE} = 10 \text{ V}$ $-C_{re}$ typ. 230 fF ¹⁾Noise figure $I_E = 2 \text{ mA}; -V_{CB} = 10 \text{ V}$ $G_S = 16.7 \text{ m}\Omega^{-1}; B_S = 0$ $f = 200 \text{ MHz}$ F typ. 3 dB $f = 800 \text{ MHz}$ F typ. 5 dB $f = 900 \text{ MHz}$ F < 6 dB $f = 900 \text{ MHz}$ F typ. 6 dB $f = 900 \text{ MHz}$ F < 7 dBMaximum unilateralised power gain $G_{UM} = \frac{1}{4} |y_{fb}|^2$ $I_E = 2 \text{ mA}; -V_{CB} = 10 \text{ V}; f = 800 \text{ MHz}$ G_{UM} typ. 17 dB¹⁾ 1 fF = 1 femtofarad = 10^{-15} F ¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS (continued)

Transducer gain at $T_{amb} = 25^\circ\text{C}$

Basic circuit for measuring the transducer gain G_{tr} at $f = 800$ and 900 MHz.



$$G_{tr} = \frac{\text{output power in load } G_L}{\text{available power from source } G_S}$$

$I_E = 2$ mA; $-V_{CB} = 10$ V; lead length: 3 mm; can connected to earth.

$f = 50$ MHz; $G_C = 0.25$ mΩ⁻¹

G_{tr} typ. 22.5 dB

$f = 200$ MHz; $G_C = 0.4$ mΩ⁻¹

G_{tr} typ. 21.5 dB

$f = 500$ MHz; $G_C = 0.5$ mΩ⁻¹

G_{tr} typ. 18 dB

$f = 800$ MHz; $G_C = 0.5$ mΩ⁻¹

G_{tr} > 11.5 dB

$G_C = 2$ mΩ⁻¹

G_{tr} typ. 14 dB

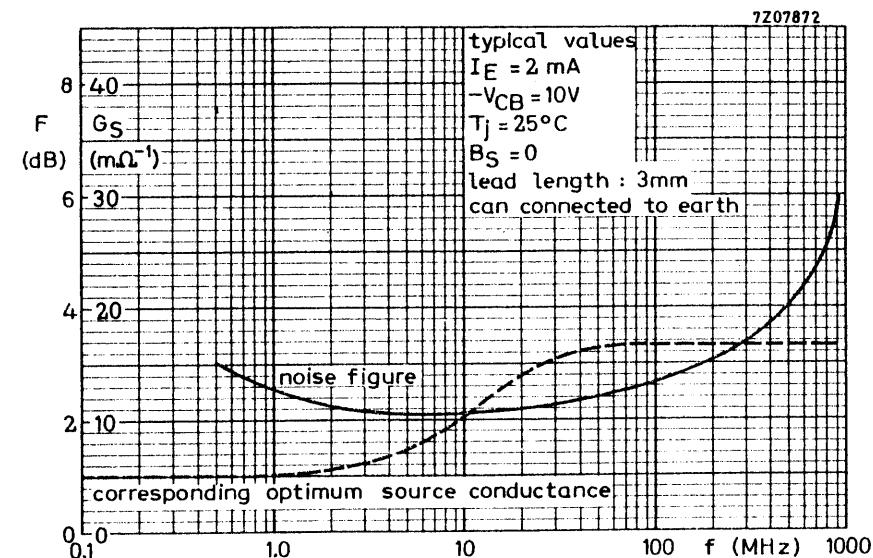
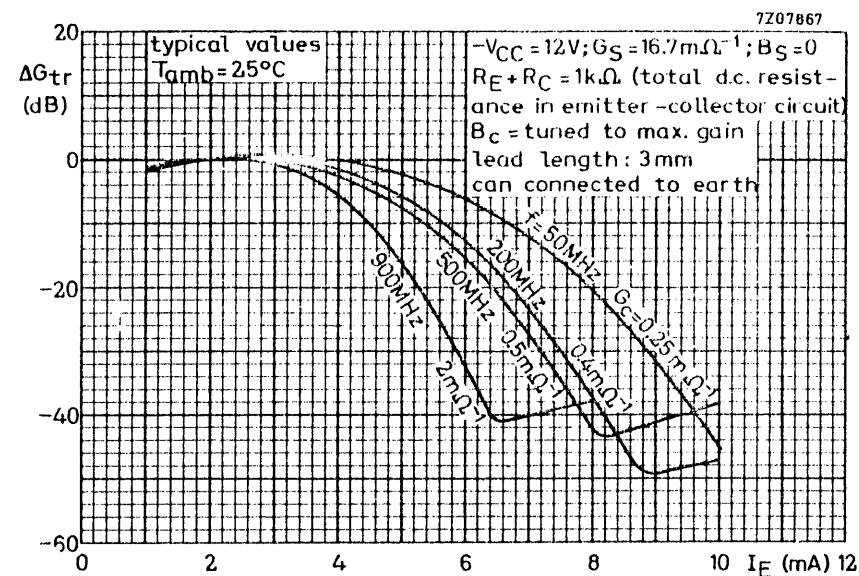
$f = 900$ MHz; $G_C = 0.5$ mΩ⁻¹

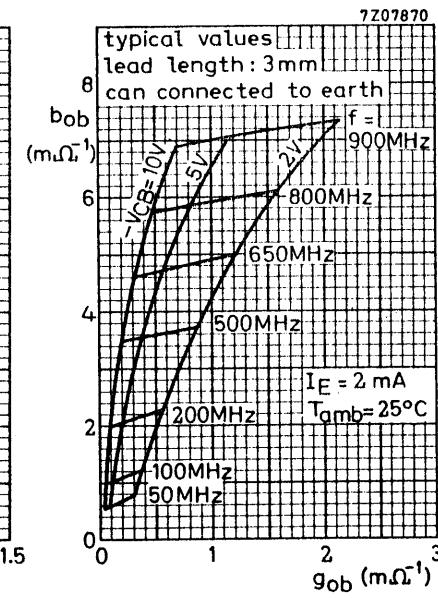
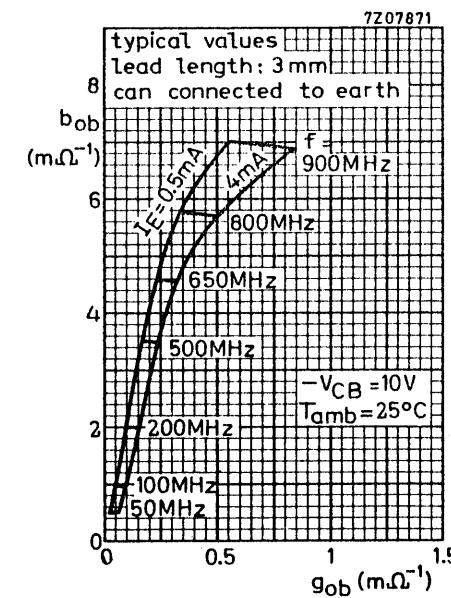
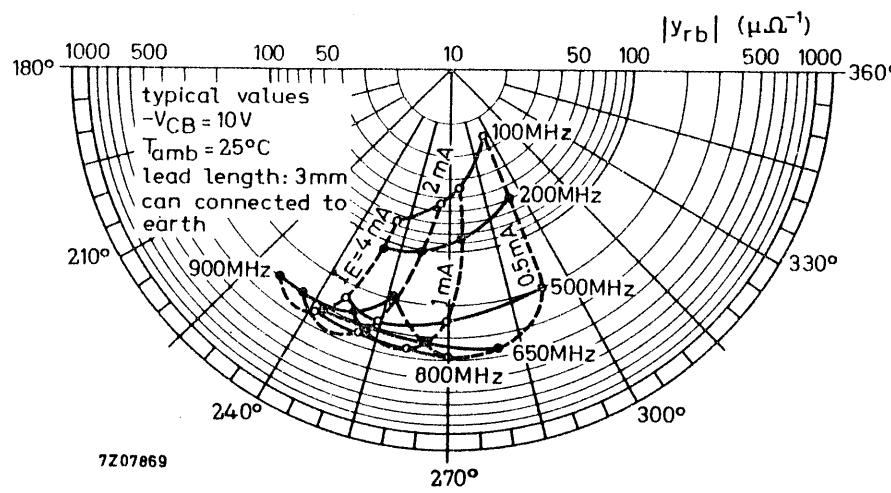
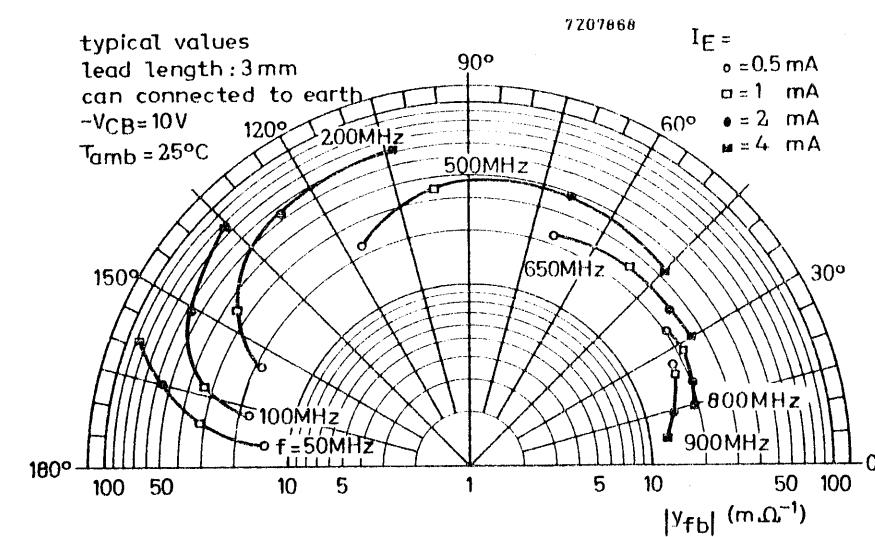
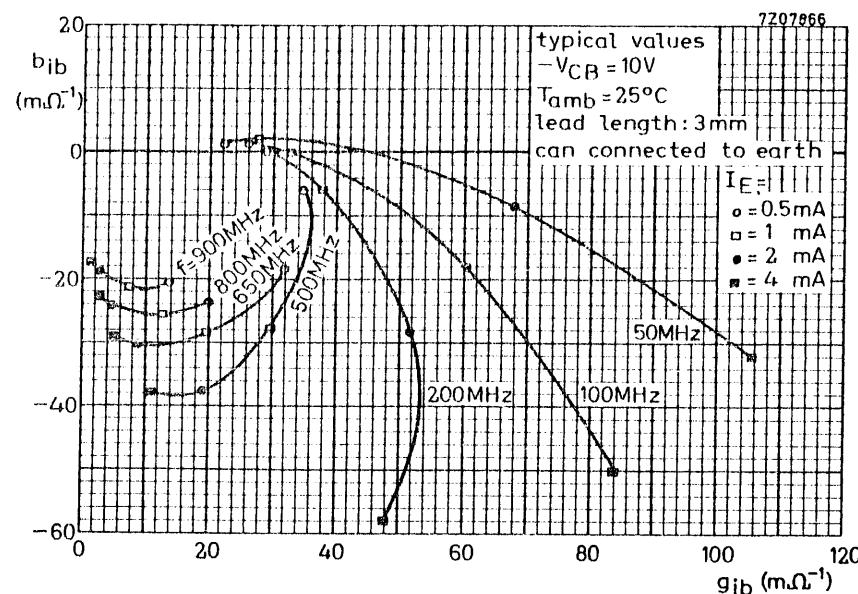
G_{tr} typ. 12.5 dB

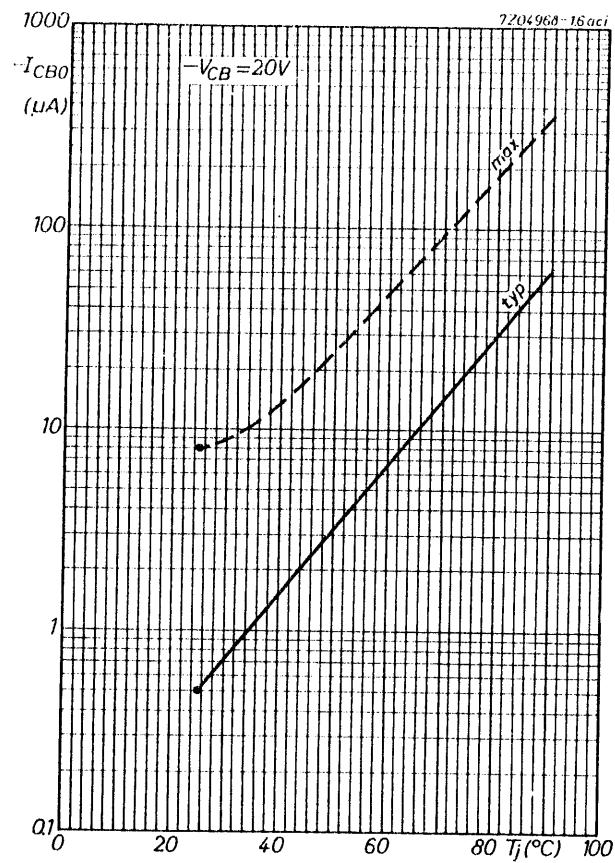
$G_C = 2$ mΩ⁻¹

G_{tr} typ. 10.5 dB

G_C = total effective collector conductance.







TRANSISTORI AL SILICIO
PER BASSA FREQUENZA
E IMPIEGHI GENERALI

A.F. SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a TO-18 metal envelope with the collector connected to the case; the same transistors are available in lock-fit encapsulation under the type numbers BC147 to BC149.

The BC107 is primarily intended for use in driver stages of audio amplifiers and in signal processing circuits of television receivers.

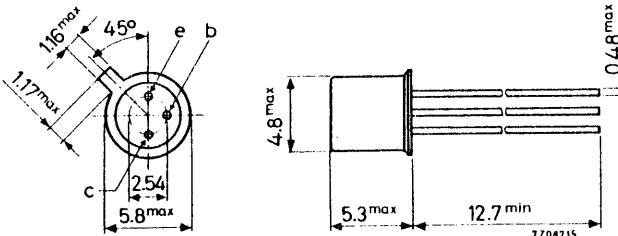
The BC108 is suitable for a multitude of low voltage applications e.g., driver stages or audio pre-amplifiers and in signal processing circuits of television receivers.

The BC109 is primarily intended for low noise input stages in tape recorders, hi-fi amplifiers and other audio frequency equipment.

	QUICK REFERENCE DATA		
	BC107	BC108	BC109
Collector-emitter voltage ($V_{BE} = 0$)	V_{CES} max. 50	30	30 V
Collector-emitter voltage (open base)	V_{CEO} max. 45	20	20 V
Collector current (peak value)	I_{CM} max. 200	200	200 mA
Total power dissipation up to $T_{amb} = 25^\circ\text{C}$	P_{tot} max. 300	300	300 mW
Junction temperature	T_j max. 175	175	175 $^\circ\text{C}$
Small signal current gain at $T_j = 25^\circ\text{C}$ $I_C = 2 \text{ mA}; V_{CE} = 5 \text{ V}; f = 1 \text{ kHz}$	h_{fe} > < 500	125 900	240 900
Transition frequency $I_C = 10 \text{ mA}; V_{CE} = 5 \text{ V}$	f_T typ. 300	300	300 MHz
Noise figure at $R_S = 2 \text{ k}\Omega$ $I_C = 200 \mu\text{A}; V_{CE} = 5 \text{ V}$ $f = 30 \text{ Hz to } 15 \text{ kHz}$	F typ. <		1.8 dB 4 dB
$f = 1 \text{ kHz}; B = 200 \text{ Hz}$	F typ. 2	2	dB

MECHANICAL DATA

Connector connected
to case
TO-18



Dimensions in mm

Accessories available: 56246; 56263

RATINGS (Limiting values)¹⁾

Voltages		BC107	BC108	BC109	V
Collector-base voltage (open emitter)	V_{CBO}	max.	50	30	30
Collector-emitter voltage ($V_{BE} = 0$)	V_{CES}	max.	50	30	30
Collector-emitter voltage (open base)	V_{CEO}	max.	45	20	20
Emitter-base voltage (open collector)	V_{EBO}	max.	6	5	5

Currents

Collector current (d.c.)	I_C	max.	100	mA
Collector current (peak value)	I_{CM}	max.	200	mA
Emitter current (peak value)	$-I_{EM}$	max.	200	mA
Base current (peak value)	I_{BM}	max.	200	mA

Power dissipation

Total power dissipation up to $T_{amb} = 25^\circ\text{C}$	P_{tot}	max.	300	mW
--	-----------	------	-----	----

Temperatures

Storage temperature	T_{stg}	-65 to +175	$^\circ\text{C}$
Junction temperature	T_j	max.	175 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th j-a}$	=	0.5	$^\circ\text{C}/\text{mW}$
From junction to case	$R_{th j-c}$	=	0.2	$^\circ\text{C}/\text{mW}$

CHARACTERISTICS $T_j = 25^\circ\text{C}$ unless otherwise specified**Collector cut-off current**

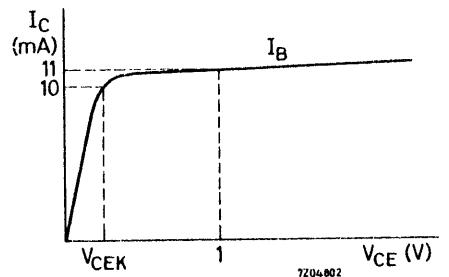
$I_E = 0$; $V_{CB} = 20$ V; $T_j = 150^\circ\text{C}$	I_{CBO}	<	15	μA
--	-----------	---	----	---------------

Base-emitter voltage²⁾

$I_C = 2$ mA; $V_{CE} = 5$ V	V_{BE}	typ.	620	mV
$I_C = 10$ mA; $V_{CE} = 5$ V	V_{BE}	<	770	mV

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

2) V_{BE} decreases by about 2 mV/ $^\circ\text{C}$ with increasing temperature.

CHARACTERISTICS (continued) $T_j = 25^\circ\text{C}$ unless otherwise specified**Saturation voltages¹⁾** $I_C = 10$ mA; $I_B = 0.5$ mA V_{CESat} typ. 90 mV V_{BESat} typ. 700 mV $I_C = 100$ mA; $I_B = 5$ mA V_{CESat} typ. 200 mV V_{BESat} typ. 600 mV**Knee voltage** $I_C = 10$ mA; I_B = value for which
 $I_C = 11$ mA at $V_{CE} = 1$ V V_{CEK} typ. 300 mV**Collector capacitance at $f = 1$ MHz** $I_E = I_e = 0$; $V_{CB} = 10$ V C_c typ. 2.5 pF

< 4.5 pF

Emitter capacitance at $f = 1$ MHz $I_C = I_e = 0$; $V_{EB} = 0.5$ V C_e typ. 9 pF**Transition frequency** $I_C = 10$ mA; $V_{CE} = 5$ V f_T typ. 300 MHz**Small signal current gain at $f = 1$ kHz** $BC107$ $BC108$ $BC109$

h_{fe}	> 125	125	240
	< 500	900	900

 $I_C = 2$ mA; $V_{CE} = 5$ V h_{fe} $I_C = 200$ μA ; $V_{CE} = 5$ V F typ. 1.8 dB $f = 30$ Hz to 15 kHz

< 4 dB

 $f = 1$ kHz; $B = 200$ Hz F typ. 2 dB

1) V_{BESat} decreases by about 1.7 mV/ $^\circ\text{C}$ with increasing temperature.

CHARACTERISTICS (continued)

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

→ D.C. current gain

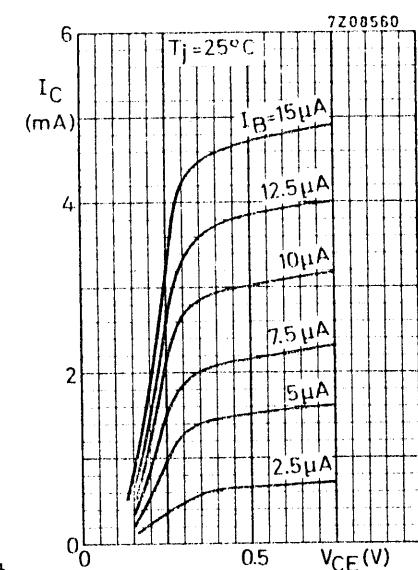
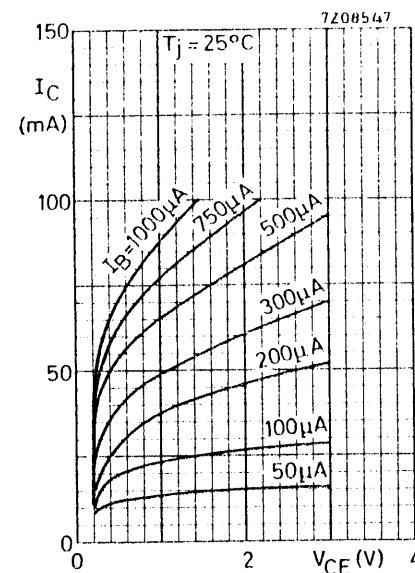
 $I_C = 10 \mu\text{A}; V_{CE} = 5 \text{ V}$

	BC107A BC108A	BC107B BC108B	BC108C BC109C
	BC109B		
h_{FE}	~ typ. 90	40 150	100 270
		> 110	200 420
$I_C = 2 \text{ mA}; V_{CE} = 5 \text{ V}$	typ. 180	290	520
	< 220	450	800

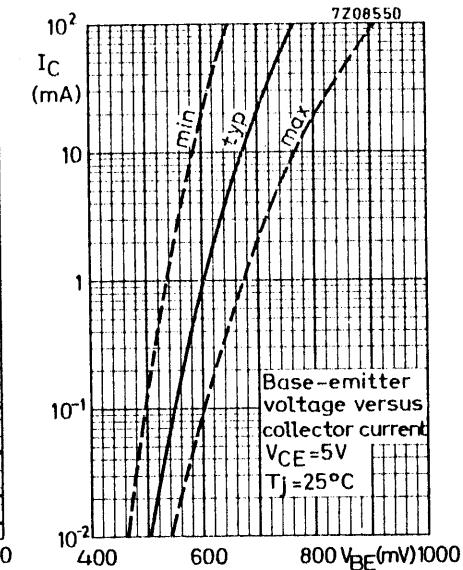
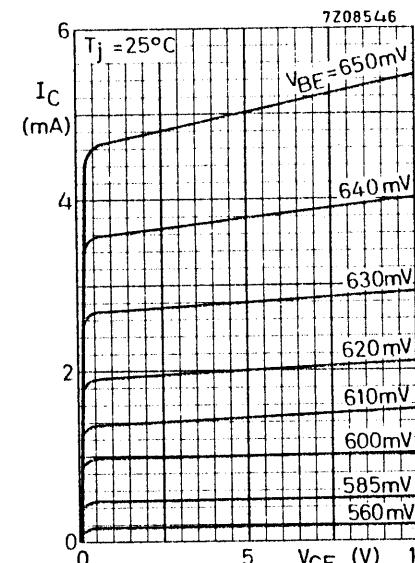
→ h parameters at $f = 1 \text{ kHz}$ (common emitter) $I_C = 2 \text{ mA}; V_{CE} = 5 \text{ V}$

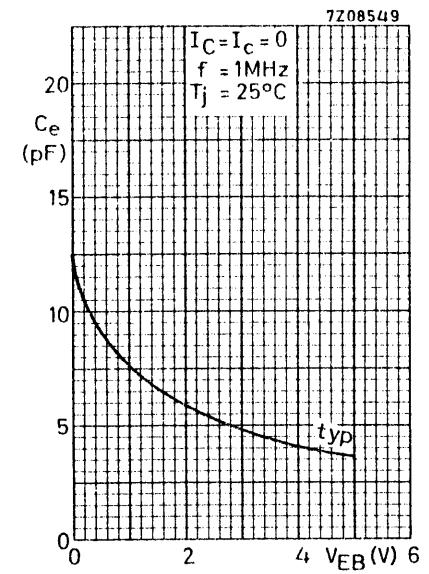
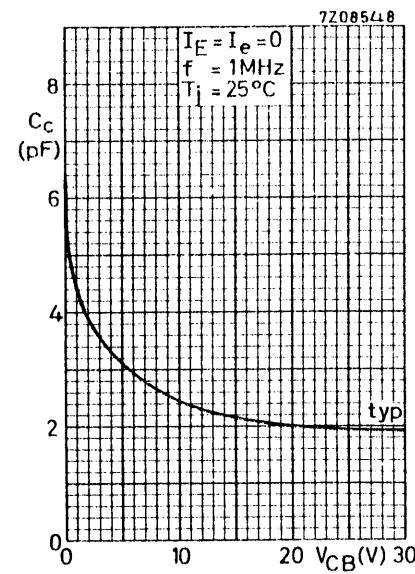
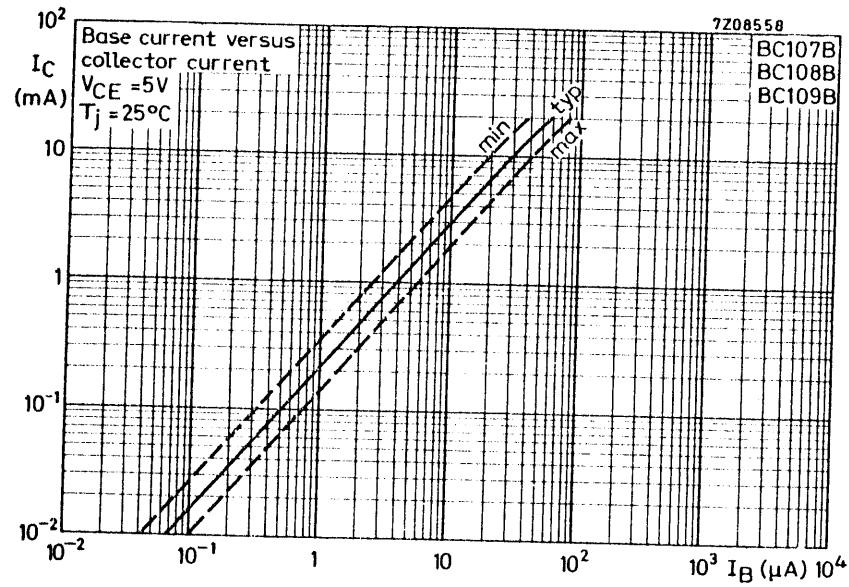
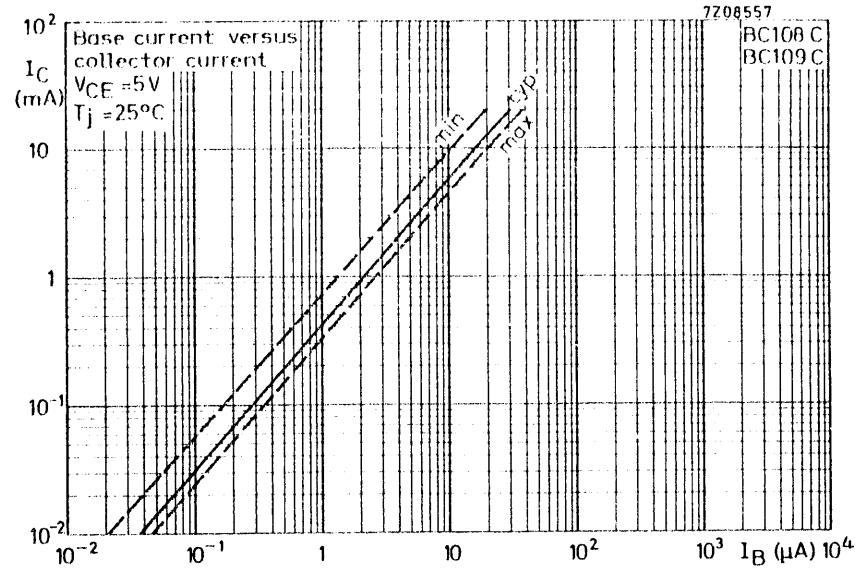
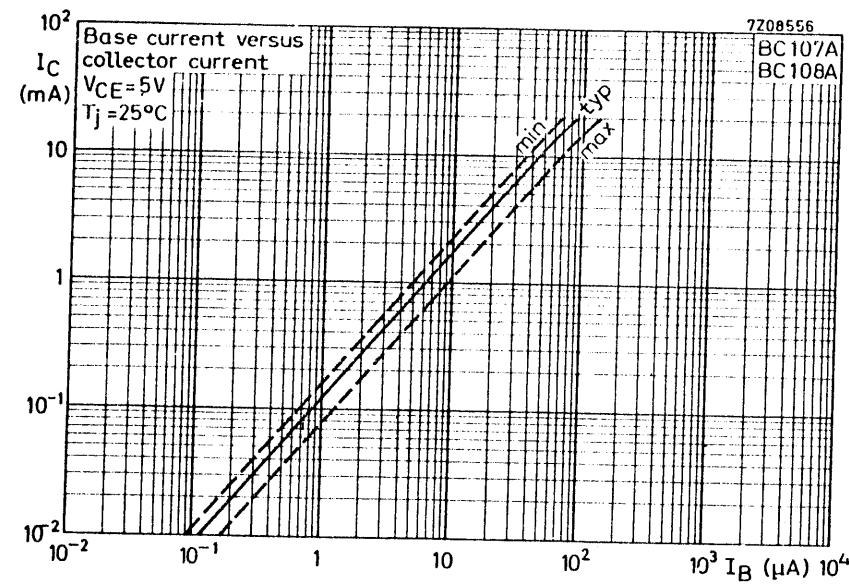
	> 1.6	3.2	6 kΩ
Input impedance	typ. 2.7	4.5	8.7 kΩ
	< 4.5	8.5	15 kΩ
Reverse voltage transfer ratio	typ. 1.5	2	$3 \cdot 10^{-4}$
	> 125	240	450
Small signal current gain	typ. 220	330	600
	< 260	500	900
Output admittance	typ. 18	30	$60 \mu\Omega^{-1}$
	< 30	60	$110 \mu\Omega^{-1}$

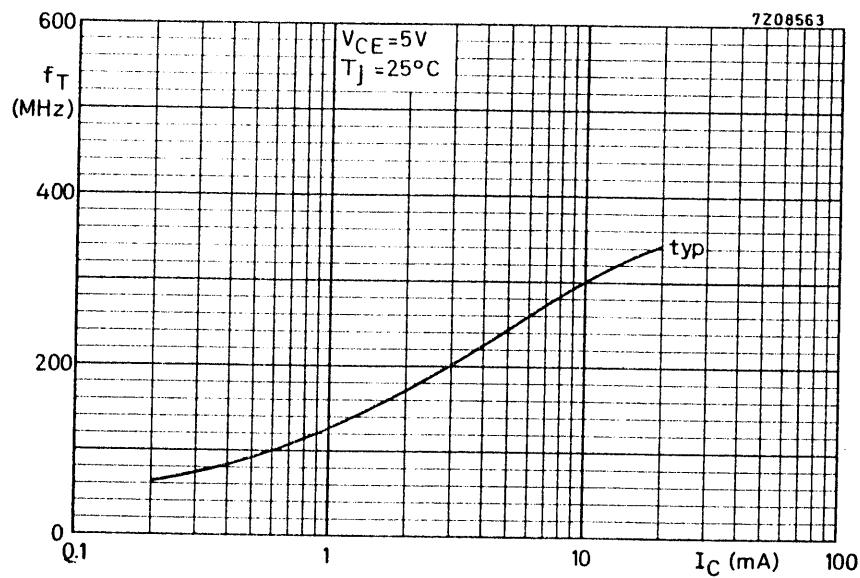
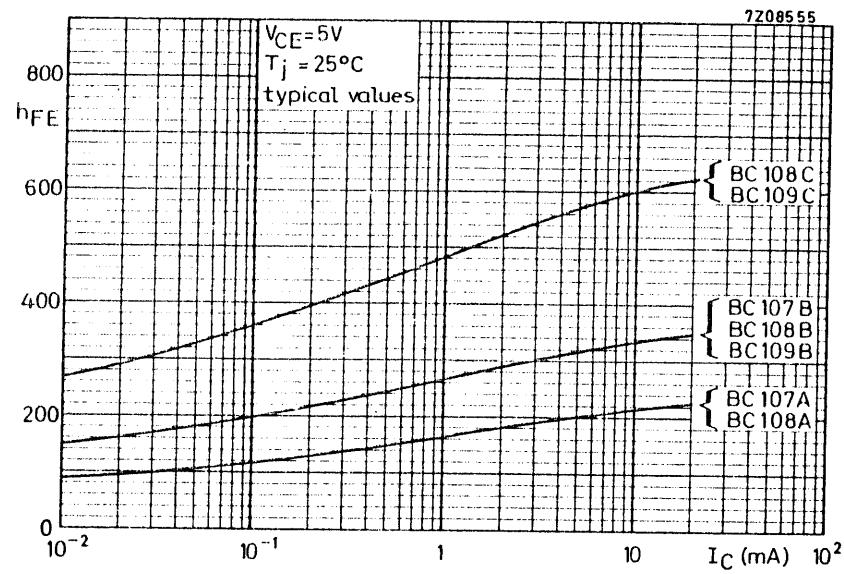
Typical behaviour of collector current versus collector-emitter voltage



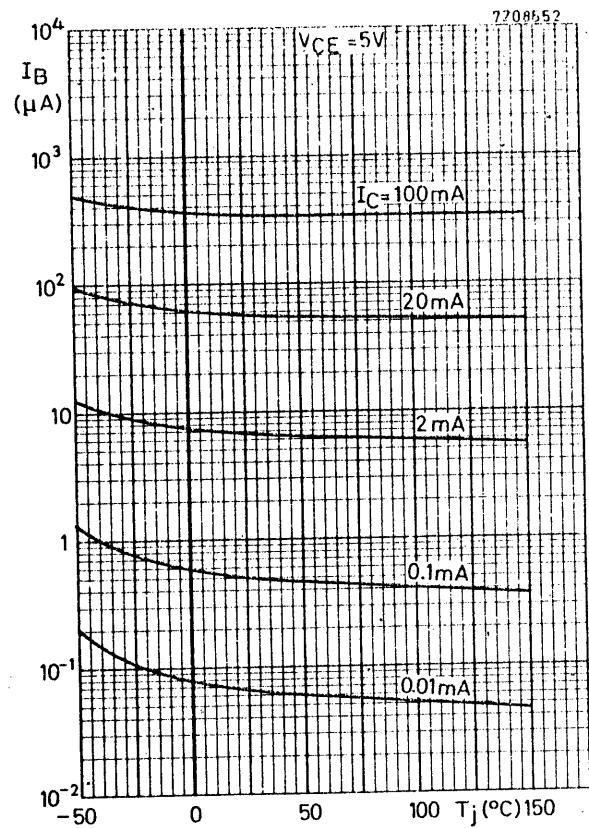
Typical behaviour of collector current versus collector-emitter voltage

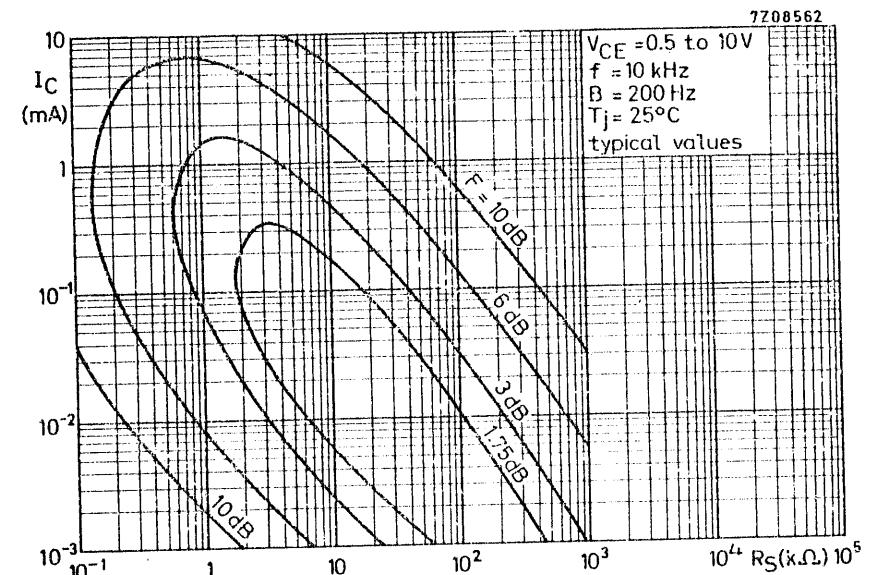
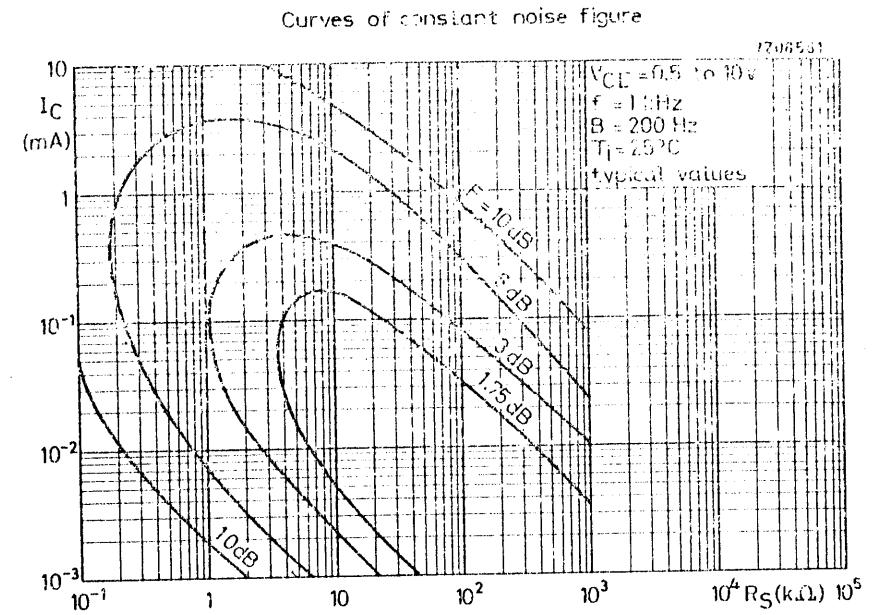
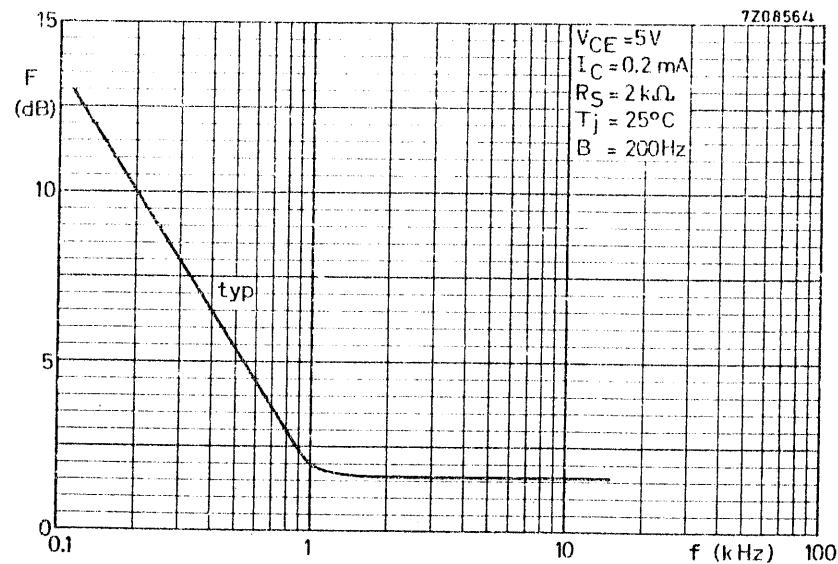
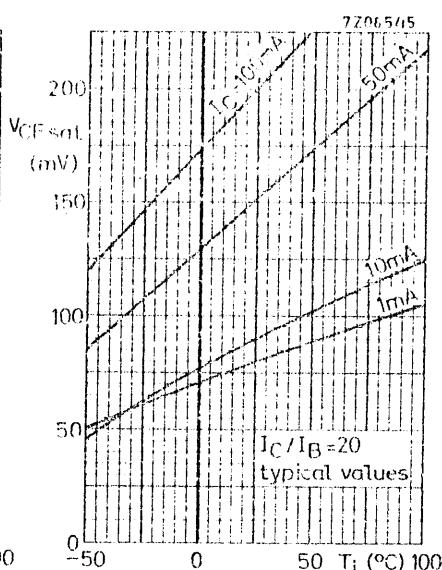
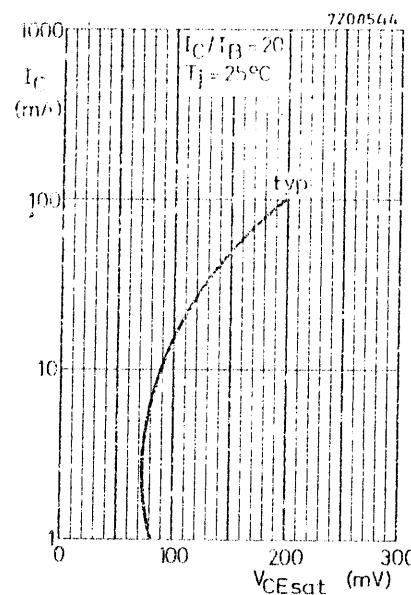


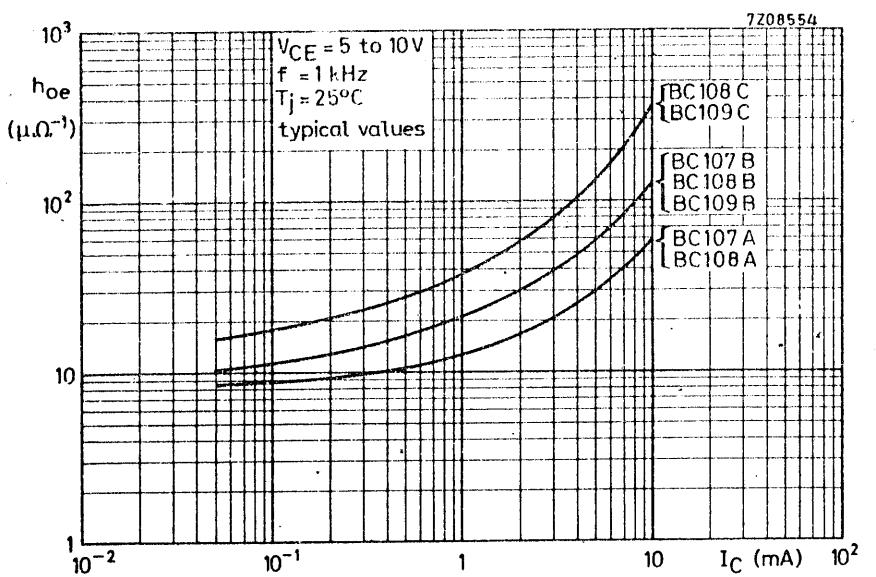
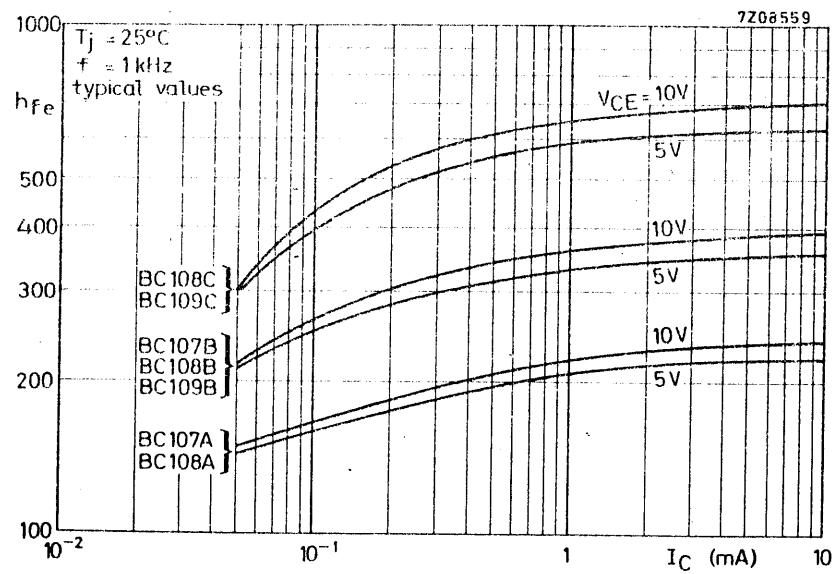
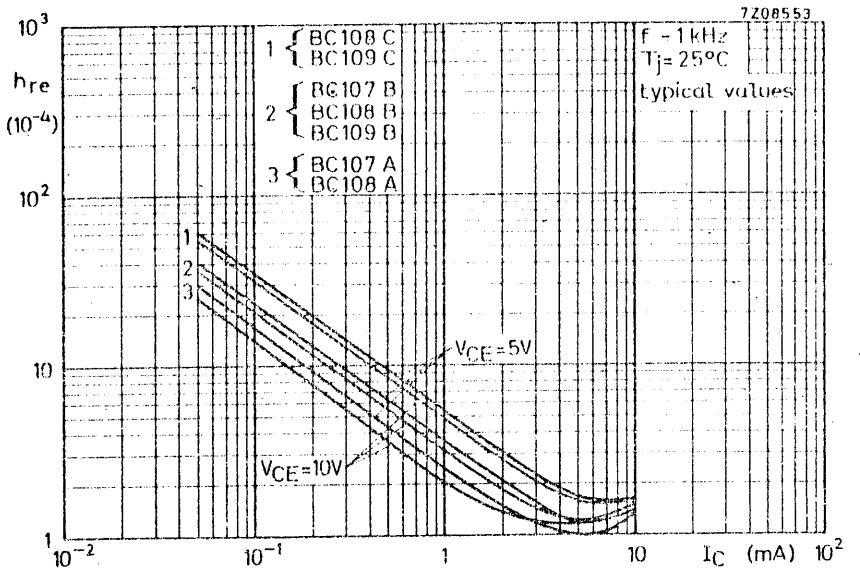
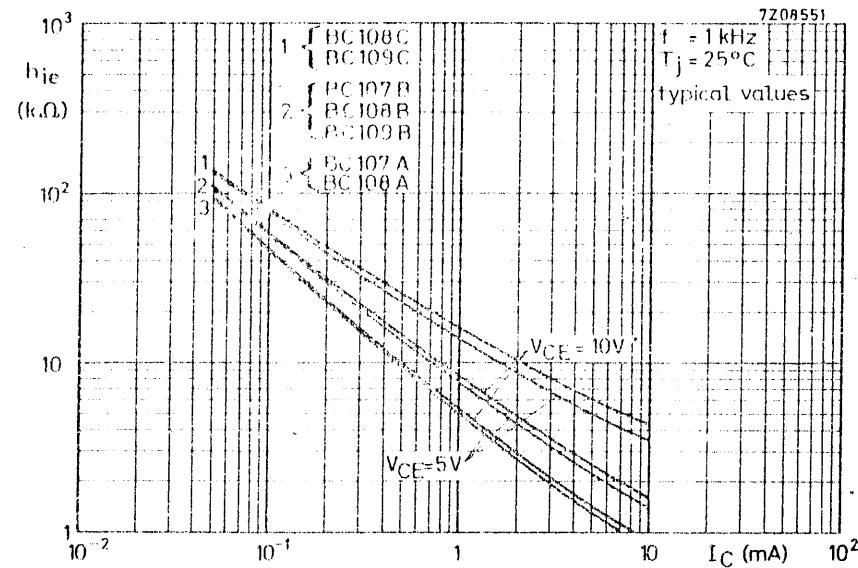




Typical behaviour of base current
versus junction temperature







A.F. SILICON PLANAR EPITAXIAL TRANSISTORS

N-P-N transistors in a plastic envelope with stiff, self-locking pins suitable for use with standard printed boards.

The BC147 is primarily intended for use in driver stages of audio amplifiers and in signal processing circuits of television receivers.

The BC148 is suitable for a multitude of low voltage applications e.g. driver stages or audio pre-amplifiers and in signal processing circuits of television receivers.

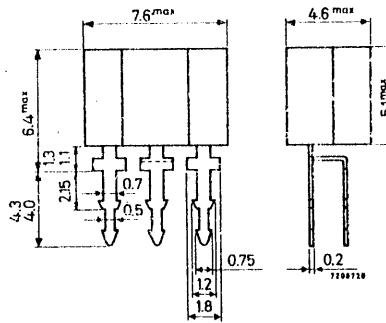
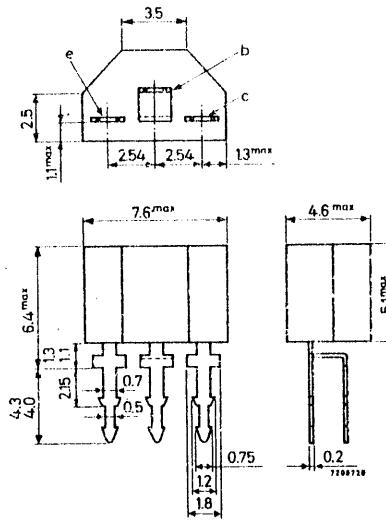
The BC149 is primarily intended for low noise input stages in tape recorders, hi-fi amplifiers and other audio frequency equipment.

QUICK REFERENCE DATA

		BC147	BC148	BC149
Collector-emitter voltage ($V_{BE} = 0$)	V_{CES}	max. 50	30	.30 V
Collector-emitter voltage (open base)	V_{CEO}	max. 45	20	20 V
Collector current (peak value)	I_{CM}	max. 200	200	200 mA
Total power dissipation up to $T_{amb} = 25^\circ\text{C}$	P_{tot}	max. 220	220	220 mW
Junction temperature	T_J	max. 125	125	125 $^\circ\text{C}$
Small signal current gain at $T_J = 25^\circ\text{C}$ $I_C = 2 \text{ mA}; V_{CE} = 5 \text{ V}; f = 1 \text{ kHz}$	h_{fe}	> 125 < 500	125 900	240 900
Transition frequency $I_C = 10 \text{ mA}; V_{CE} = 5 \text{ V}$	f_T	typ. 300	300	300 MHz
Noise figure at $R_S = 2 \text{ k}\Omega$ $I_C = 200 \mu\text{A}; V_{CE} = 5 \text{ V}$	F	typ. <		1.8 dB 4 dB
$f = 30 \text{ Hz to } 15 \text{ kHz}$	F	typ. <	2	dB
$f = 1 \text{ kHz}; B = 200 \text{ Hz}$	F	typ. 2	2	

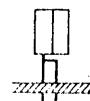
MECHANICAL DATA

Dimensions in mm

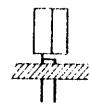


MOUNTING INSTRUCTIONS

1. Thickness of printed board: max. 1.1 mm
Hole diameter 0.77 to 0.83 mm



2. Thickness of printed board: max. 1.7 mm
Hole diameter 1.25 to 1.35 mm



Bore plan 

RATINGS (Limiting values)¹⁾

Voltages

		BC147	BC148	BC149
Collector-base voltage (open emitter)	V _{CBO}	max. 50	30	30 V
Collector-emitter voltage ($V_{BE} = 0$)	V _{CES}	max. 50	30	30 V
Collector-emitter voltage (open base)	V _{CEO}	max. 45	20	20 V
Emitter-base voltage (open collector)	V _{EBO}	max. 6	5	5 V

Currents

Collector current (d.c.)	I _C	max. 100 mA
Collector current (peak value)	I _{CM}	max. 200 mA
Emitter current (peak value)	I _{EM}	max. 200 mA
Base current (peak value)	I _{BM}	max. 200 mA

Power dissipation

Total power dissipation up to $T_{amb} = 25^\circ\text{C}$ P_{tot} max. 220 mW

Temperatures

Storage temperature	T _{stg}	-65 to +125 °C
Junction temperature	T _j	max. 125 °C

THERMAL RESISTANCE

From junction to ambient in free air R_{th j-a} = 0.45 °C/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current

I_C = 0; V_{CB} = 20 V; T_j = 125 °C

I_{CB0} typ. 5 μA

Base-emitter voltage¹⁾

I_C = 2 mA; V_{CE} = 5 V

V_{BE} typ. 620 mV
550 to 700 mV

I_C = 10 mA; V_{CE} = 5 V

V_{BE} < 770 mV

Saturation voltages²⁾

I_C = 10 mA; I_B = 0.5 mA

V_{CESat} typ. 90 mV
< 250 mV

I_C = 100 mA; I_B = 5 mA

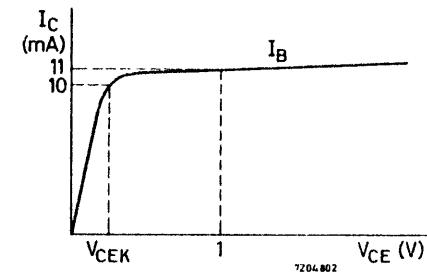
V_{CESat} typ. 200 mV
< 600 mV

I_C = 100 mA; I_B = value for which

I_C = 11 mA at V_{CE} = 1 V

V_{CEK} typ. 300 mV
< 600 mV

Knee voltage



Collector capacitance at f = 1 MHz

I_E = I_e = 0; V_{CB} = 10 V

C_c typ. 2.5 pF
< 4.5 pF

Emitter capacitance at f = 1 MHz

I_C = I_c = 0; V_{EB} = 0.5 V

C_e typ. 9 pF

Transition frequency

I_C = 10 mA; V_{CE} = 5 V

f_T typ. 300 MHz

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

2) V_{BEsat} decreases by about 1.7 mV/°C with increasing temperature.

CHARACTERISTICS (continued) $T_j = 25^\circ\text{C}$ unless otherwise specifiedSmall signal current gain at $f = 1 \text{ kHz}$ $I_C = 2 \text{ mA}; V_{CE} = 5 \text{ V}$

		BC147	BC148	BC149
h_{FE}	>	125	125	240
h_{FE}	<	500	900	900

Noise figure at $R_S = 2 \text{ k}\Omega$ $I_C = 200 \mu\text{A}; V_{CE} = 5 \text{ V}$ $f = 30 \text{ Hz to } 15 \text{ kHz}$

	F	typ.		
	<		1.8 dB	
			4 dB	

 $f = 1 \text{ kHz}; B = 200 \text{ Hz}$

	F	typ.	2	2	2 dB
		<	10	10	4 dB

D.C. current gain $I_C = 10 \mu\text{A}; V_{CE} = 5 \text{ V}$

	h_{FE}	typ.	BC147A	BC147B	BC148C
			BC148A	BC148B	BC149C
			BC149A	BC149B	

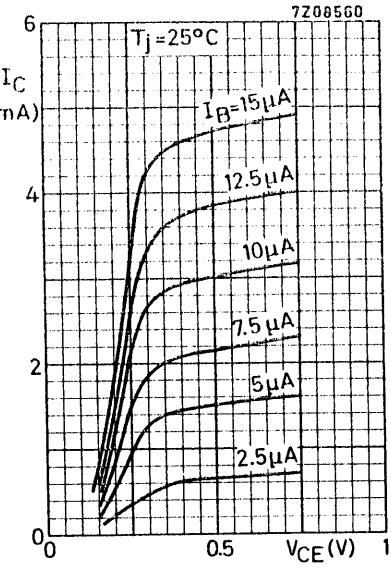
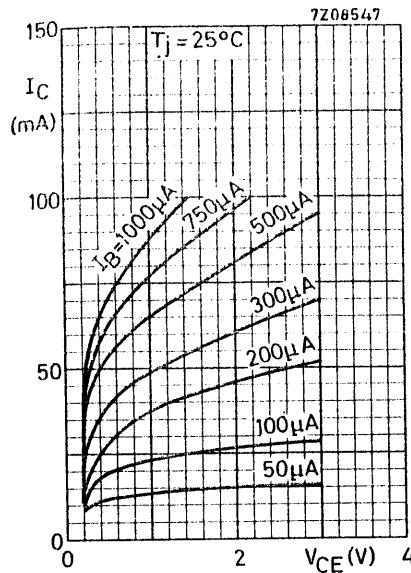
 $I_C = 2 \text{ mA}; V_{CE} = 5 \text{ V}$

	h_{FE}	typ.	180	290	520
		<	220	450	800

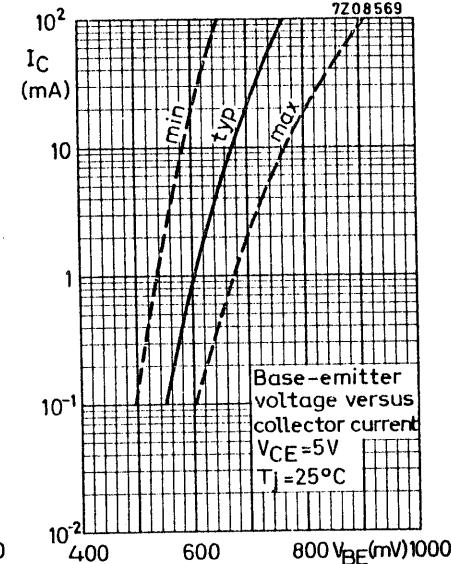
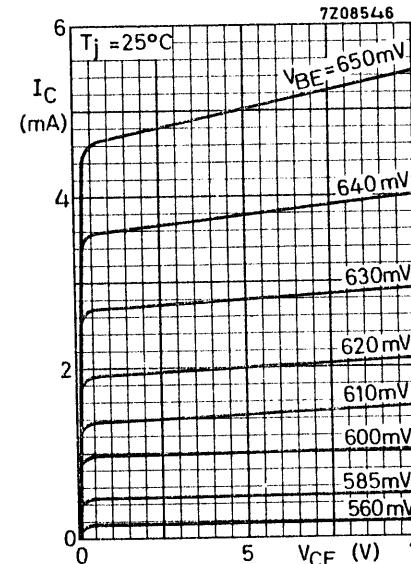
 h parameters at $f = 1 \text{ kHz}$ (common emitter) $I_C = 2 \text{ mA}; V_{CE} = 5 \text{ V}$

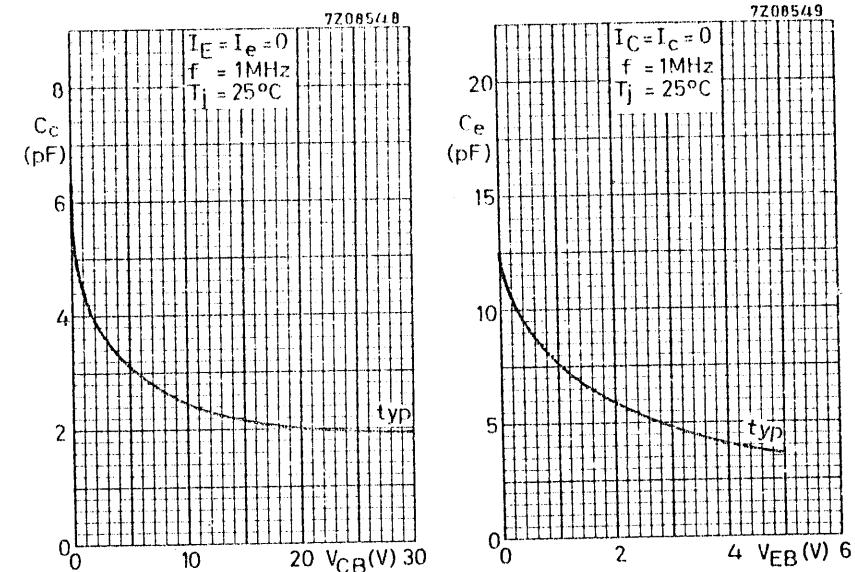
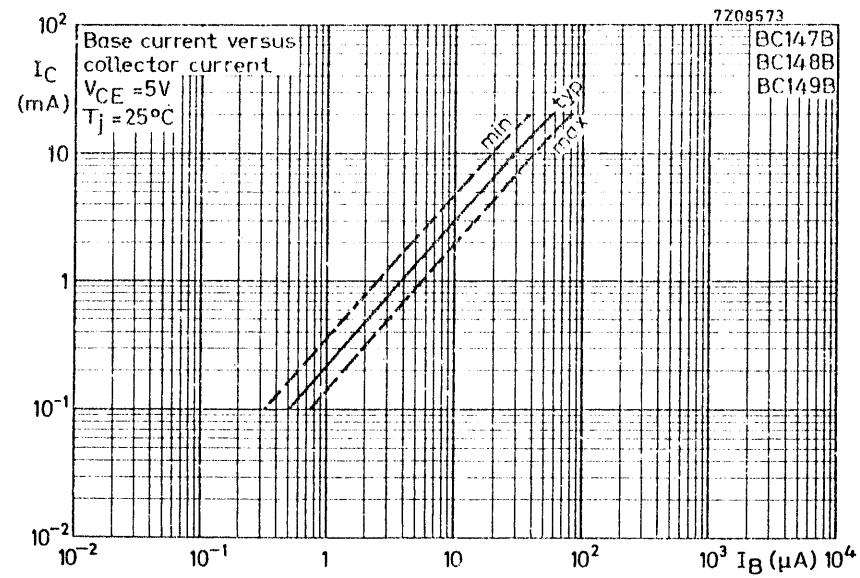
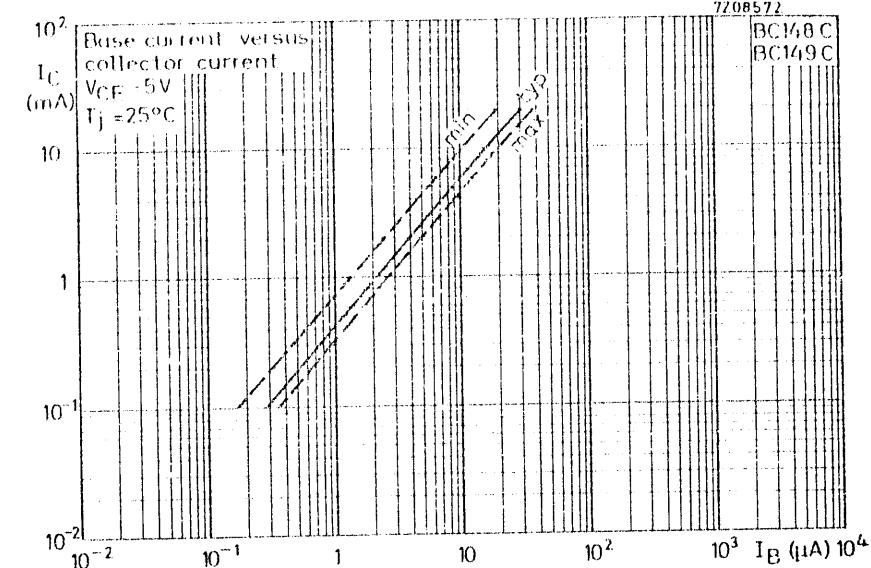
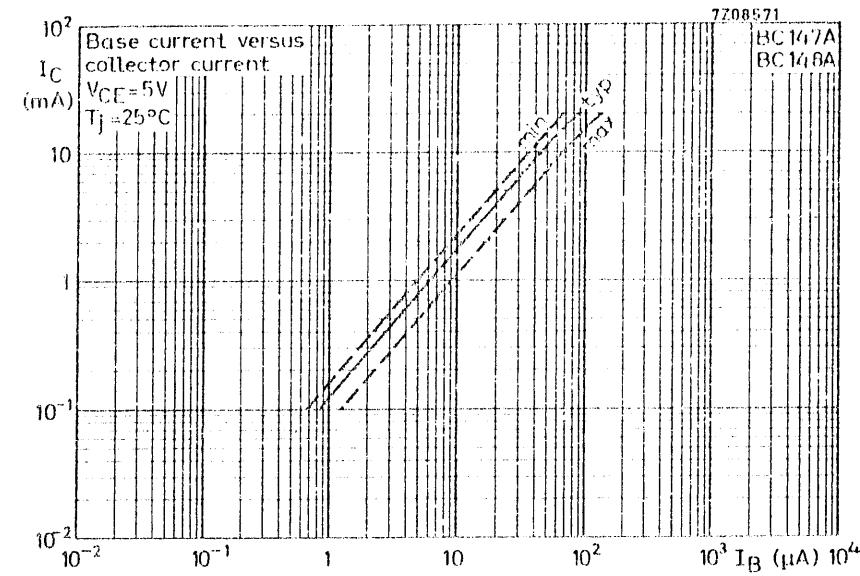
	h_{ie}	typ.	1.6	3.2	6 $\text{k}\Omega$
			2.7	4.5	8.7 $\text{k}\Omega$
		<	4.5	8.5	15 $\text{k}\Omega$
	h_{re}	typ.	1.5	2	$3 \cdot 10^{-4}$
			>	125	240
					450
	h_{fe}	typ.	220	330	600
		<	260	500	900
	h_{oe}	typ.	18	30	$60 \mu\Omega^{-1}$
		<	30	60	$110 \mu\Omega^{-1}$

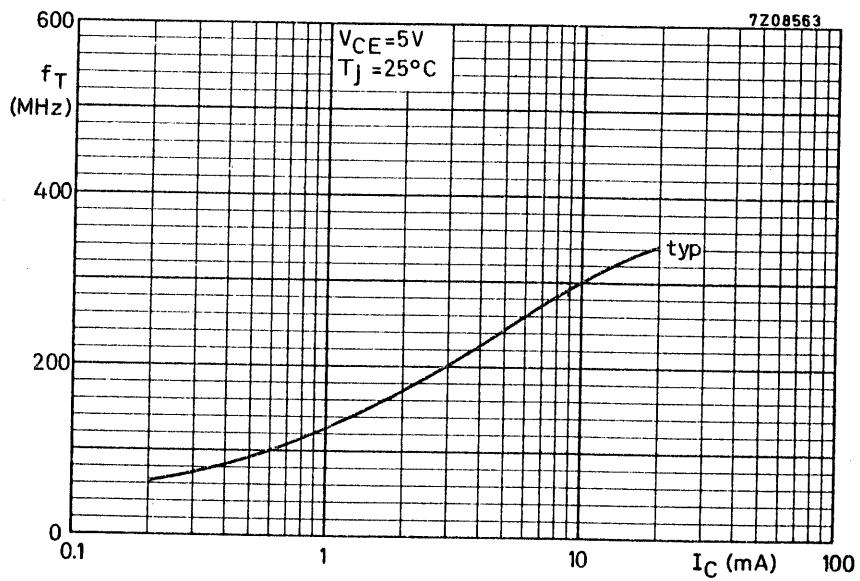
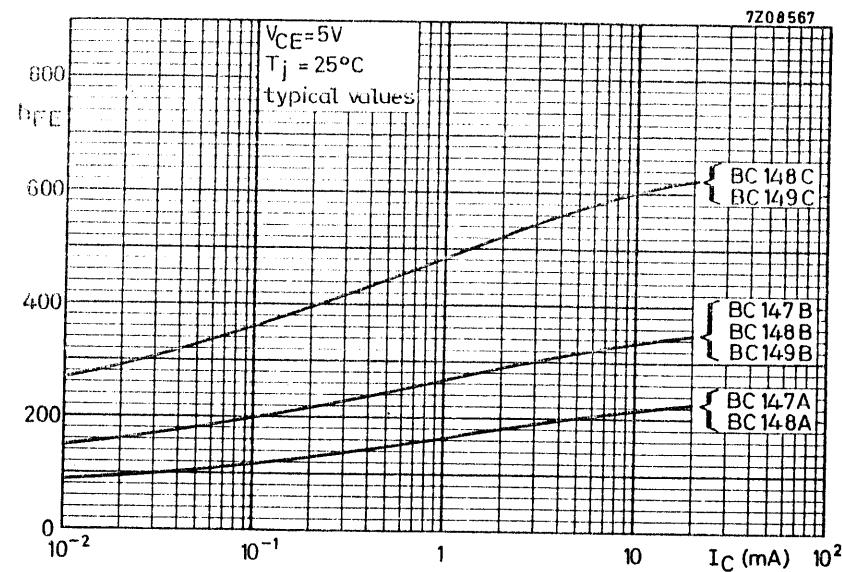
Typical behaviour of collector current versus collector-emitter voltage



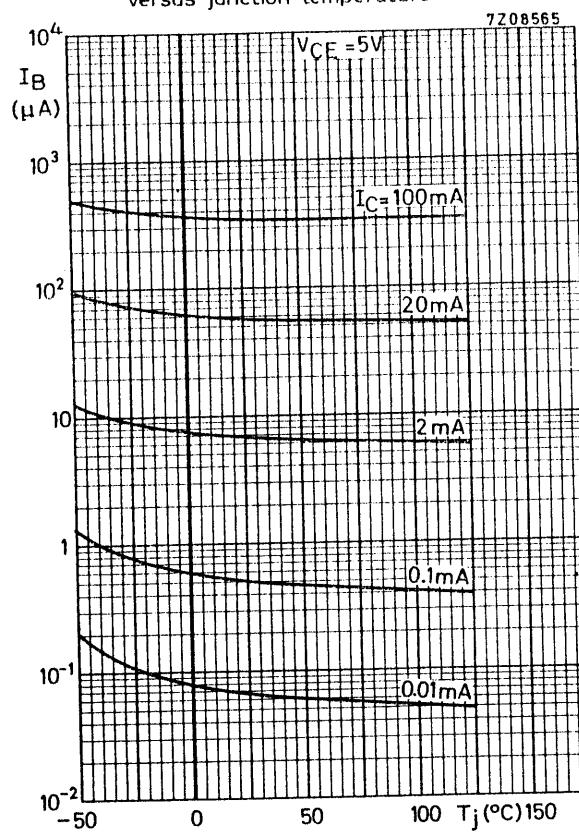
Typical behaviour of collector current versus collector-emitter voltage

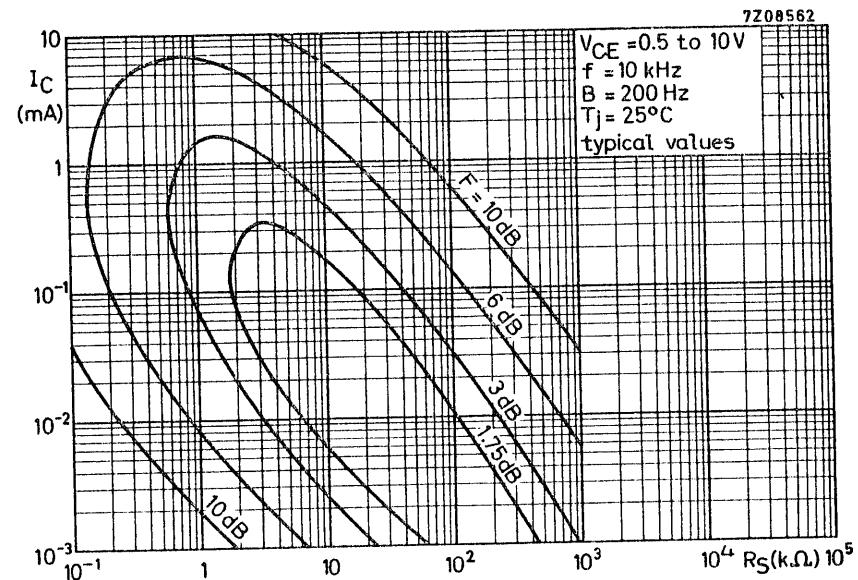
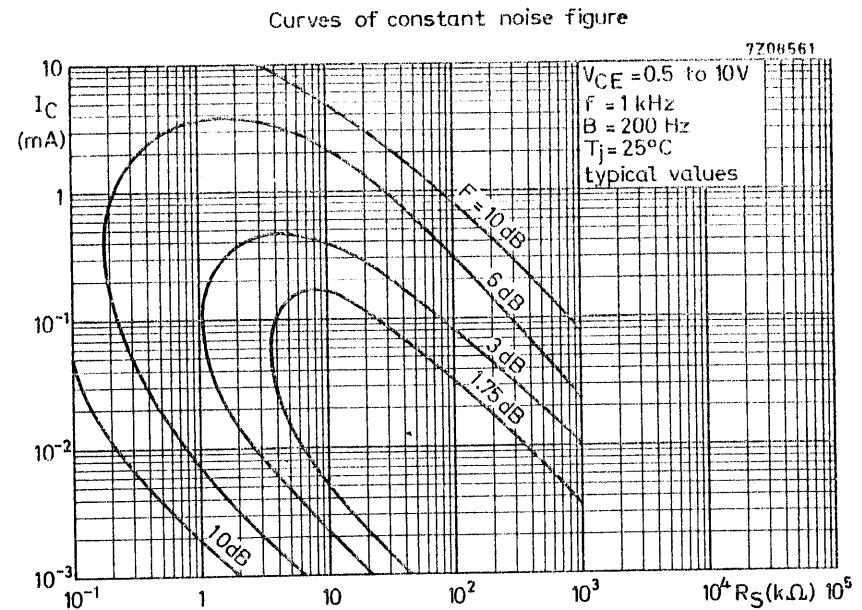
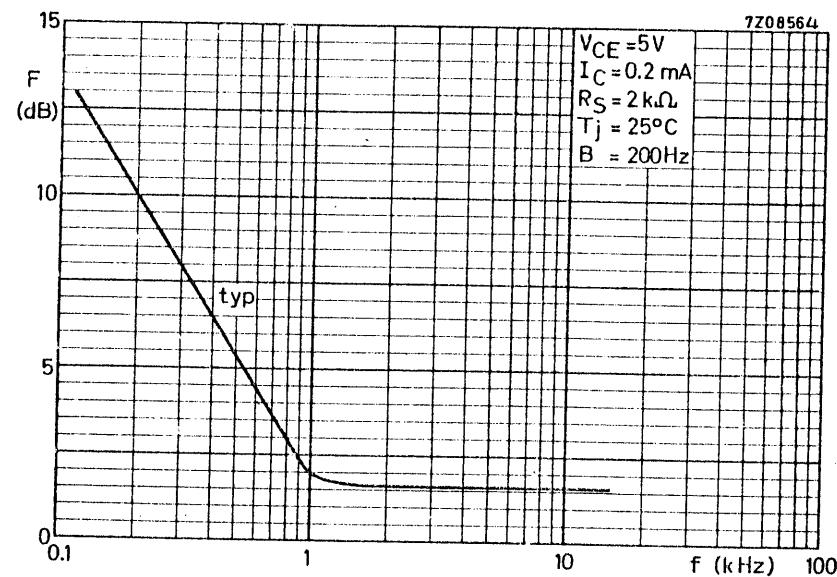
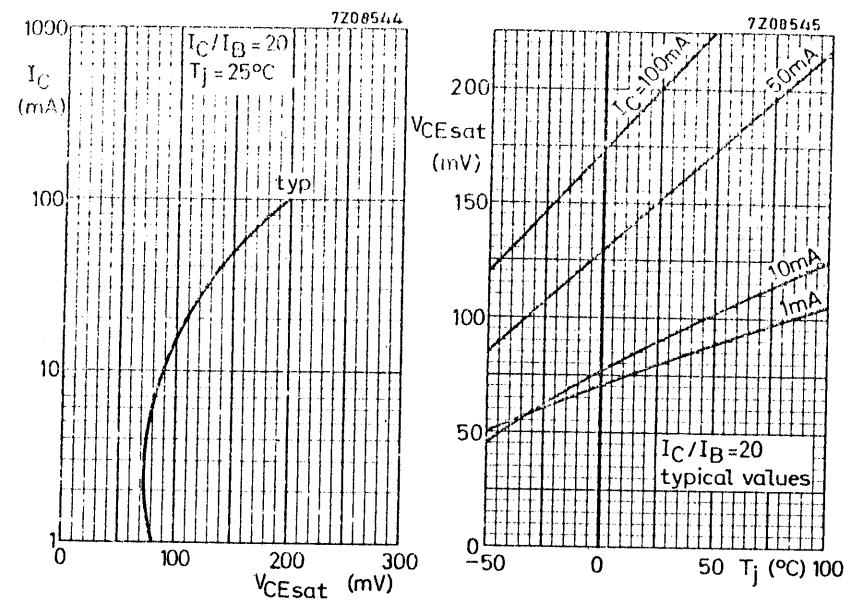


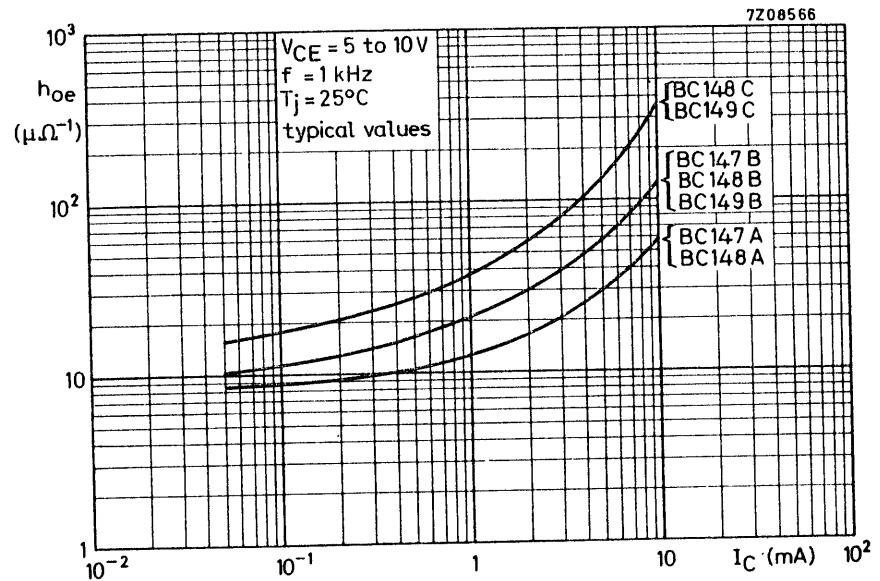
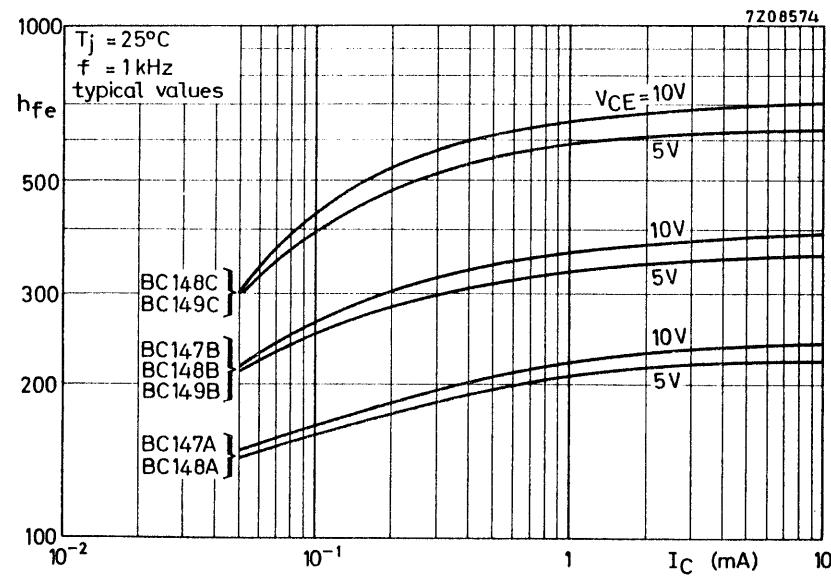
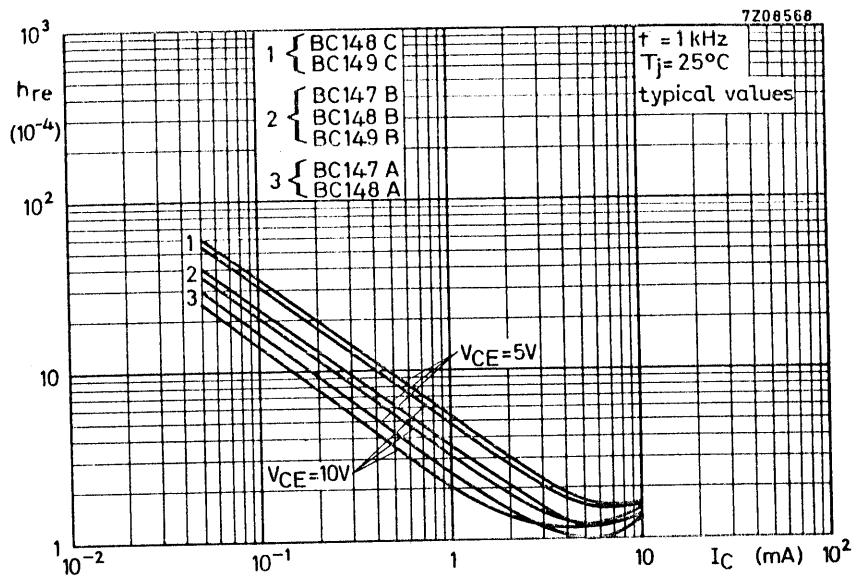
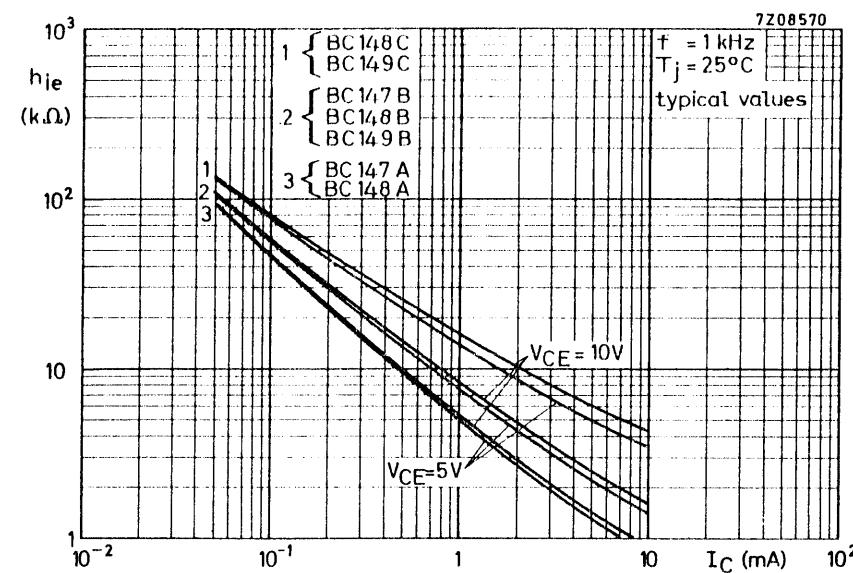




Typical behaviour of base current
versus junction temperature







A.E. SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in a plastic envelope with stiff self-locking pins suitable for use with standard printed boards.

The BC157 is a high voltage type and primarily intended for use in driver stages of audio amplifiers and in signal processing circuits of television receivers.

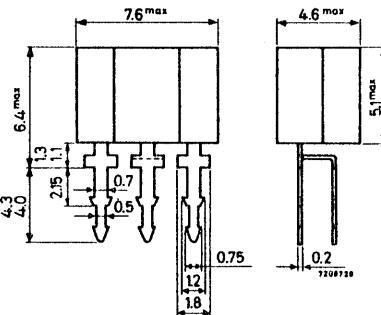
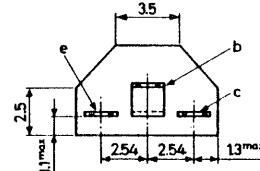
The BC158 is suitable for a multitude of low voltage applications e.g. driver stages or audio pre-amplifiers and in signal processing circuits of television receivers.

The BC159 is primarily intended for low noise input stages in tape recorders, hi-fi amplifiers and other audio frequency equipment.

	QUICK REFERENCE DATA			
	BC157	BC158	BC159	
Collector-emitter voltage ($+V_{BE} = 1$ V)	$-V_{CEX}$	max. 50	30	25 V
Collector-emitter voltage (open base)	$-V_{CEO}$	max. 45	25	20 V
Collector current (peak value)	$-I_{CM}$	max. 200	200	200 mA
Total power dissipation up to $T_{amb} = 25^\circ\text{C}$	P_{tot}	max. 250	250	250 mW
Junction temperature	T_j	max. 125	125	125 $^\circ\text{C}$
Small signal current gain at $T_j = 25^\circ\text{C}$				
$-I_C = 2$ mA; $-V_{CE} = 5$ V; $f = 1$ kHz	h_{fe}	> 75	75	125
$-I_C = 10$ mA; $-V_{CE} = 5$ V		< 260	500	500
Transition frequency at $f = 35$ MHz	f_T	typ. 150	150	150 MHz
Noise figure at $R_S = 2$ k Ω				
$-I_C = 200$ μA ; $-V_{CE} = 5$ V				
$f = 30$ Hz to 15 kHz	F	typ.		1.2 dB
$f = 1$ kHz; $B = 200$ Hz	F	< 10	10	4 dB

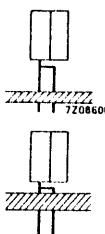
MECHANICAL DATA

Dimensions in mm

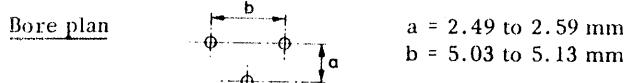


MOUNTING INSTRUCTIONS

1. Thickness of printed board: max. 1.1 mm
Hole diameter 0.77 to 0.83 mm



2. Thickness of printed board: max. 1.7 mm
Hole diameter 1.25 to 1.35 mm



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

Voltages

		BC157	BC158	BC159
Collector-base voltage (open emitter)	-V _{CBO}	max. 50	30	25 V
Collector-emitter voltage (+V _{BE} = 1 V)	-V _{CEX}	max. 50	30	25 V
Collector-emitter voltage (open base)	-V _{CEO}	max. 45	25	20 V
Emitter-base voltage (open collector)	-V _{EBO}	max. 5	5	5 V

Currents

Collector current (d.c.)	-I _C	max. 100 mA
Collector current (peak value)	-I _{CM}	max. 200 mA
Emitter current (peak value)	I _{EM}	max. 200 mA

Power dissipation

Total power dissipation up to T _{amb} = 25 °C	P _{tot}	max. 250 mW
--	------------------	-------------

Temperatures

Storage temperature	T _{stg}	-65 to +125 °C
Junction temperature	T _j	max. 125 °C

THERMAL RESISTANCE

From junction to ambient in free air	R _{th j-a}	= 0.4 °C/mW
--------------------------------------	---------------------	-------------

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current

I_E = 0; -V_{CB} = 20 V; T_j = 25 °C

-I_{CBO} typ. < 100 nA

T_j = 125 °C

-I_{CBO} typ. < 4 μA

Base-emitter voltage¹⁾

-I_C = 2 mA; -V_{CE} = 5 V

-V_{BE} typ. 650 mV
600 to 750 mV

Saturation voltages

-I_C = 10 mA; -I_B = 0.5 mA

-V_{CESat} typ. 75 mV
< 300 mV

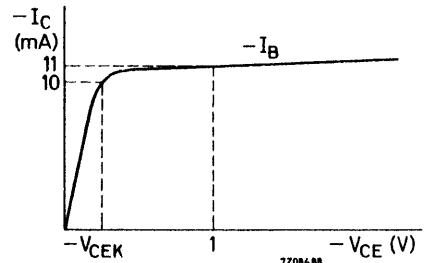
-I_C = 100 mA; -I_B = 5 mA

-V_{BESat} typ. 700 mV
-V_{CESat} typ. 250 mV
-V_{BESat} typ. 850 mV

Knee voltage

-I_C = 10 mA; -I_B = value for which
-I_C = 11 mA at -V_{CE} = 1 V

-V_{CEK} typ. 250 mV
< 600 mV

Collector capacitance at f = 1 MHz

I_E = I_e = 0; -V_{CB} = 10 V

C_c typ. 4.5 pF

Transition frequency at f = 35 MHz

-I_C = 10 mA; -V_{CE} = 5 V

f_T typ. 150 MHz

¹⁾-V_{BE} decreases by about 2 mV/°C with increasing temperature.

CHARACTERISTICS (continued)Small signal current gain at f = 1 kHz $T_j = 25^\circ\text{C}$ unless otherwise specified $-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$

		BC157	BC158	BC159
h_{FE}	>	75	75	125

Noise figure at $R_S = 2 \text{ k}\Omega$ $-I_C = 200 \mu\text{A}; -V_{CE} = 5 \text{ V}$ $f = 30 \text{ Hz to } 15 \text{ kHz}$

F	typ.		1.2	dB
	<		4	dB

 $f = 1 \text{ kHz}; B = 200 \text{ Hz}$

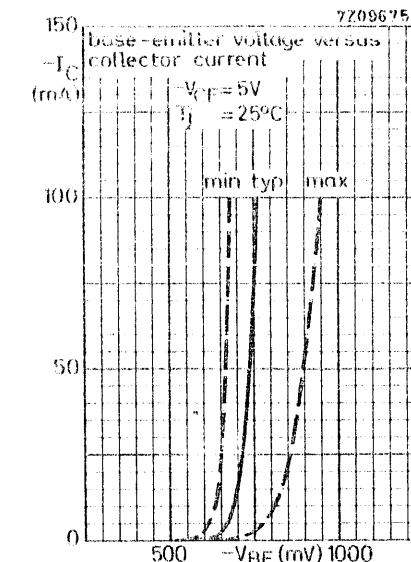
F	typ.	2	2	1	dB
	<	10	10	4	dB

D.C. current gain $-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$

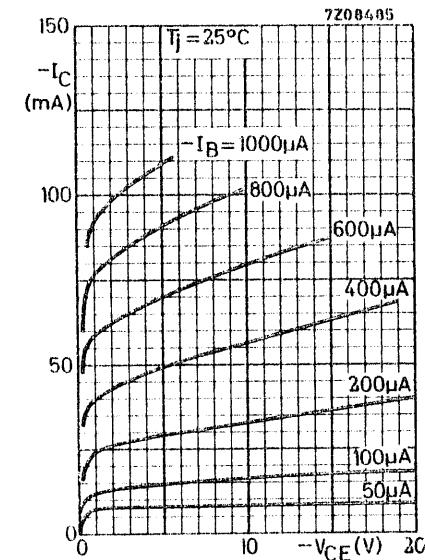
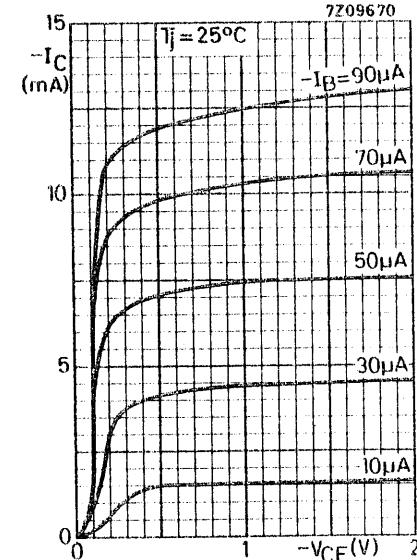
	BC157	BC158A	BC158B
h_{FE}	typ. 140	180	290

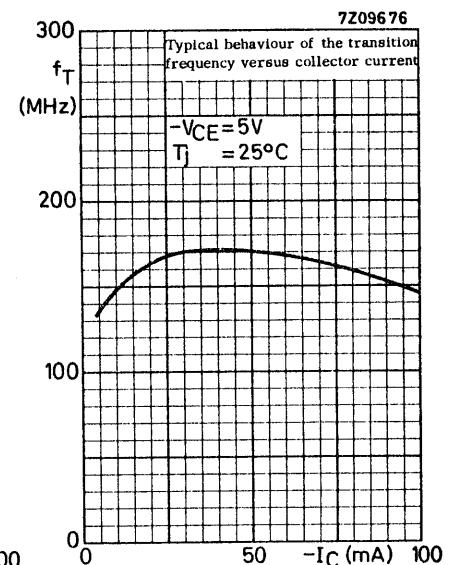
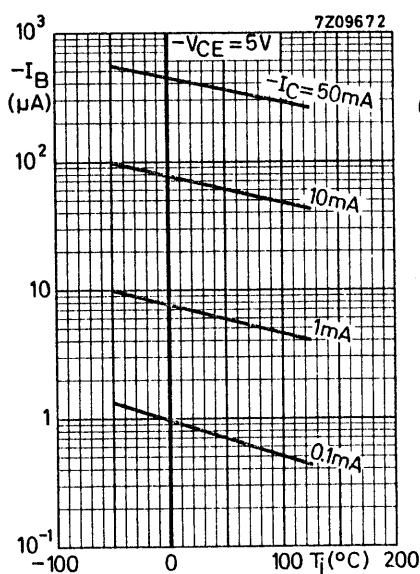
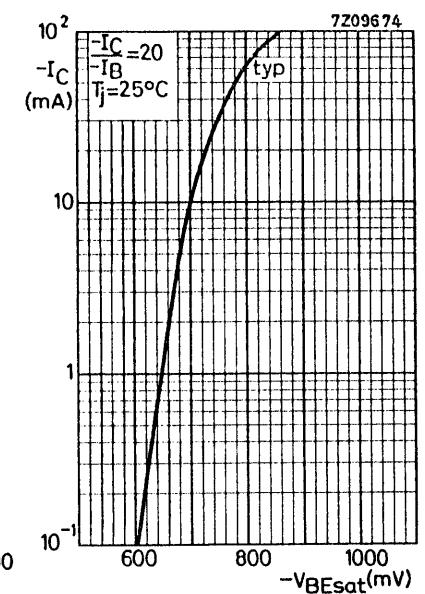
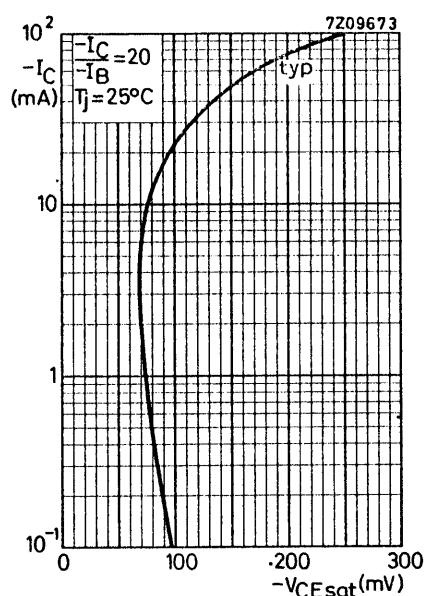
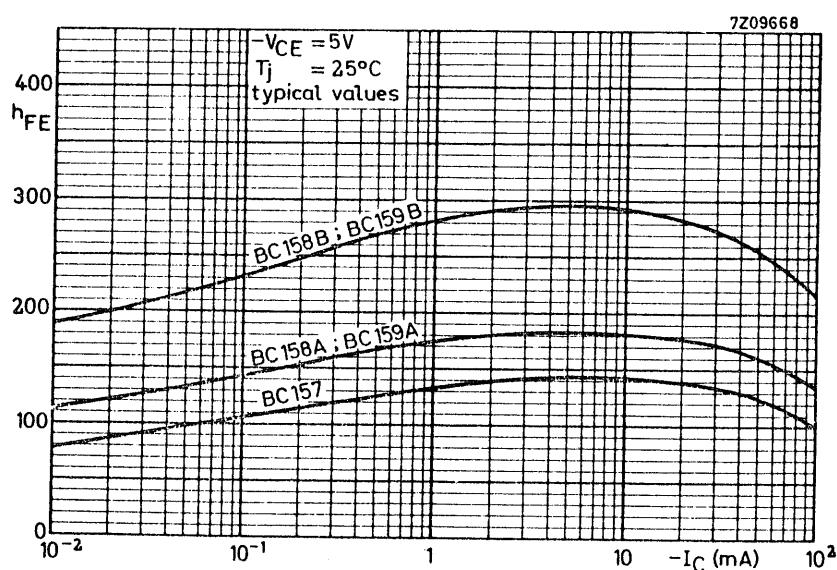
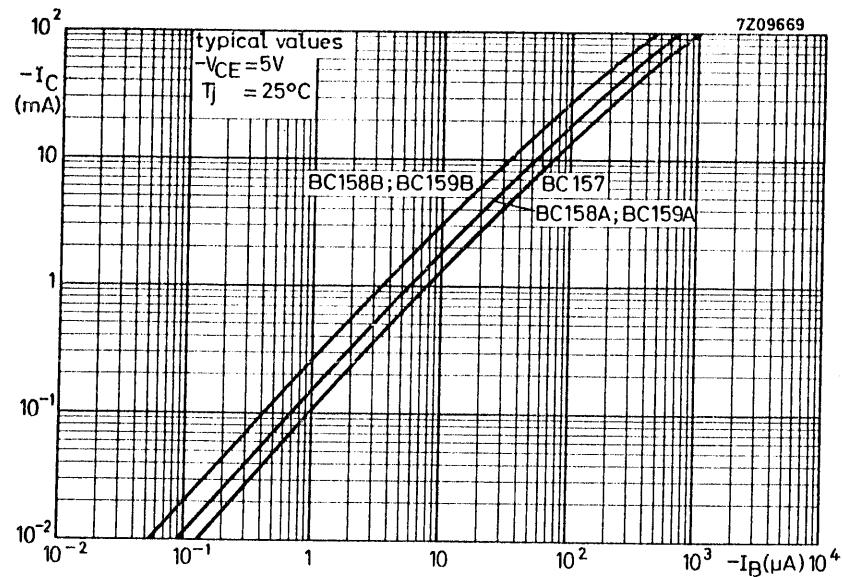
Small signal current gain at f = 1 kHz $-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$

h_{FE}	>	75	125	240
	<	260	260	500

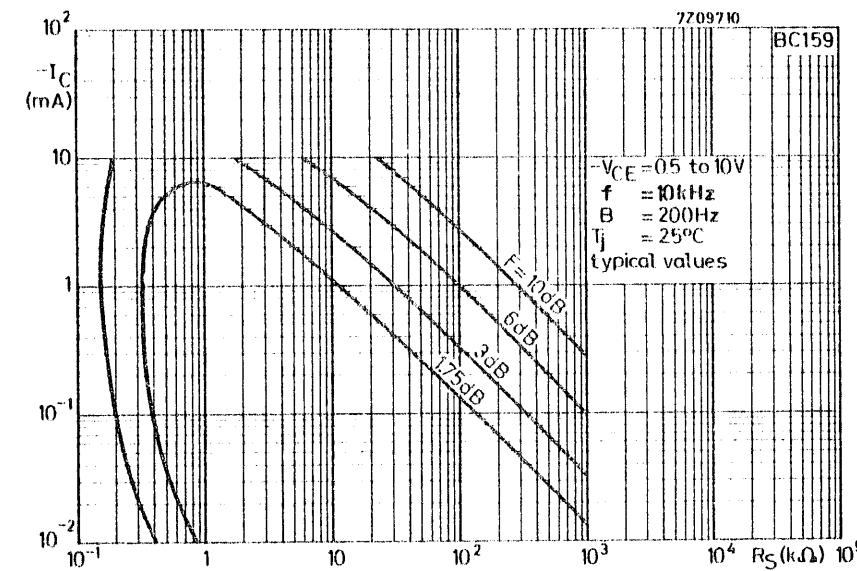
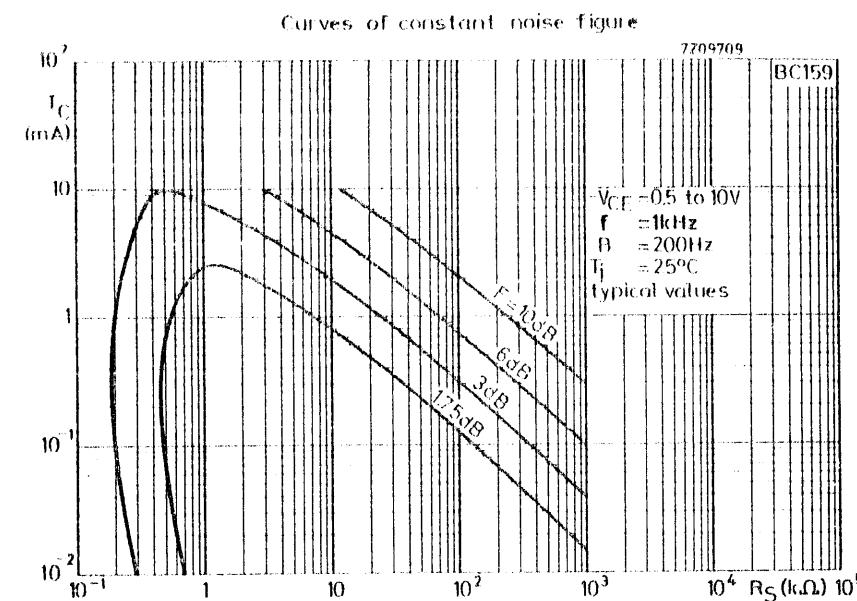
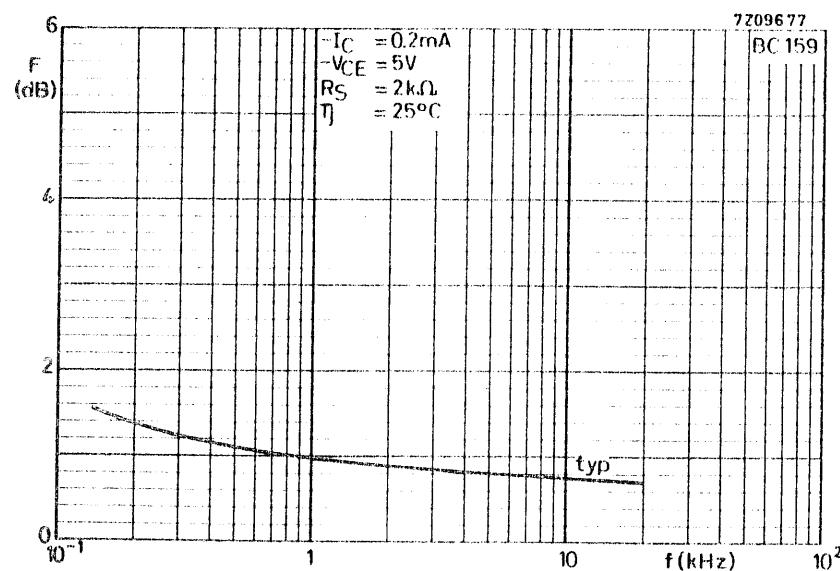
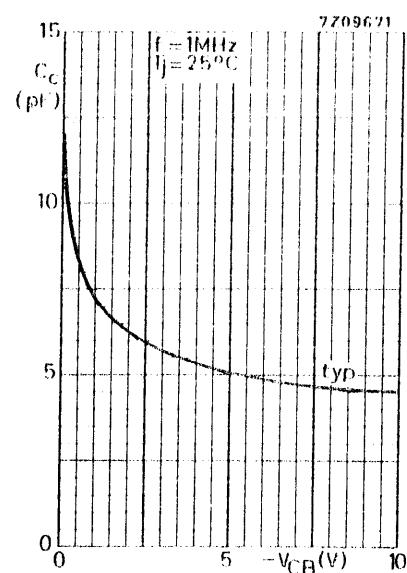


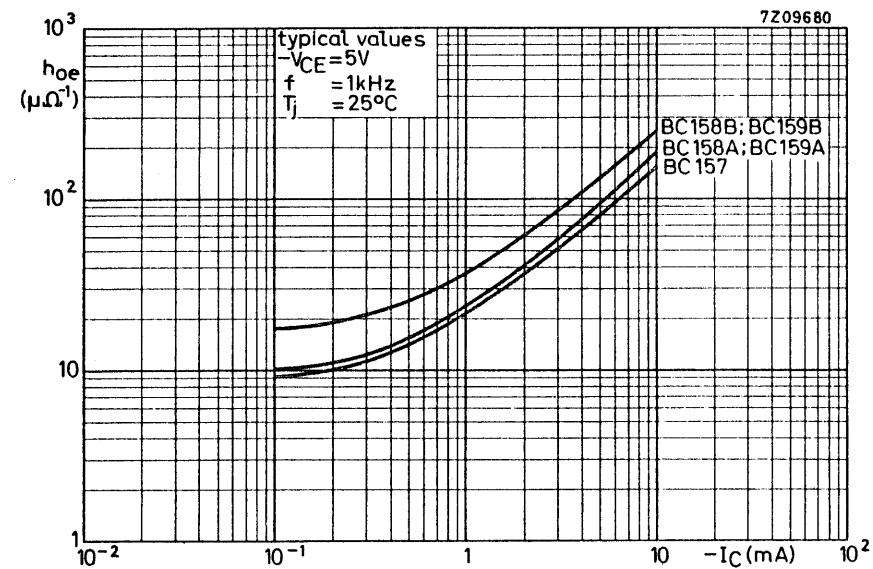
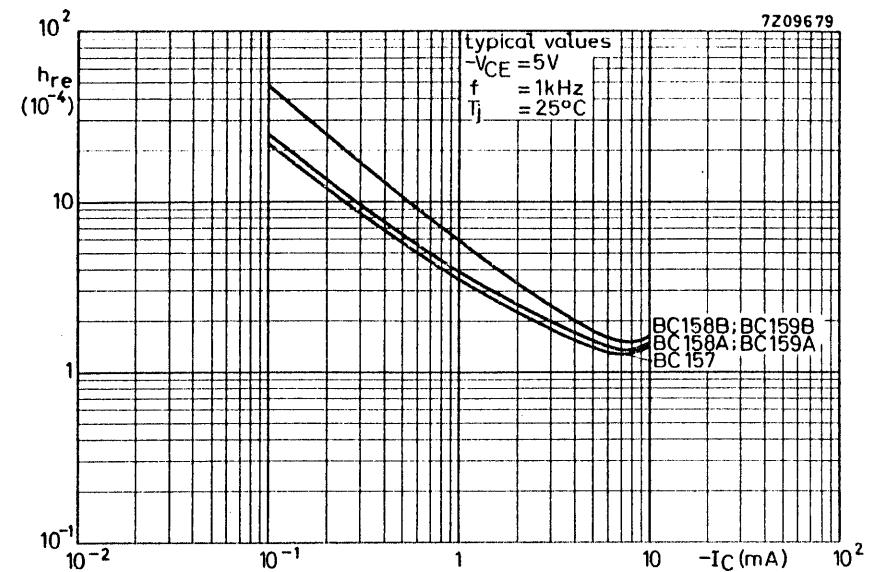
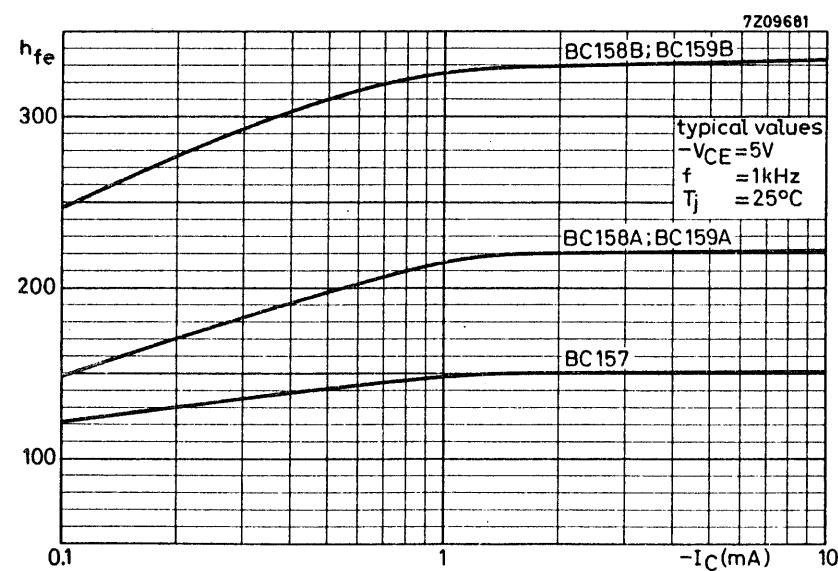
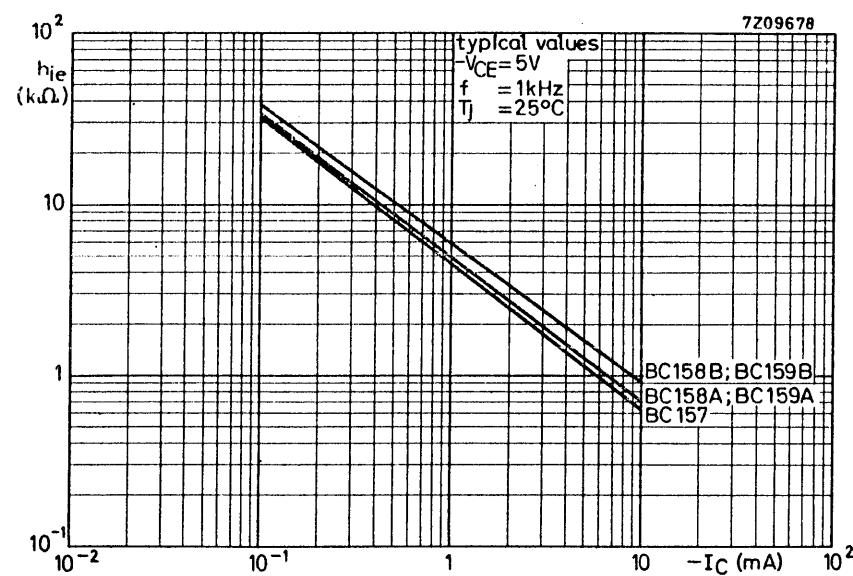
Typical behaviour of collector current versus collector-emitter voltage

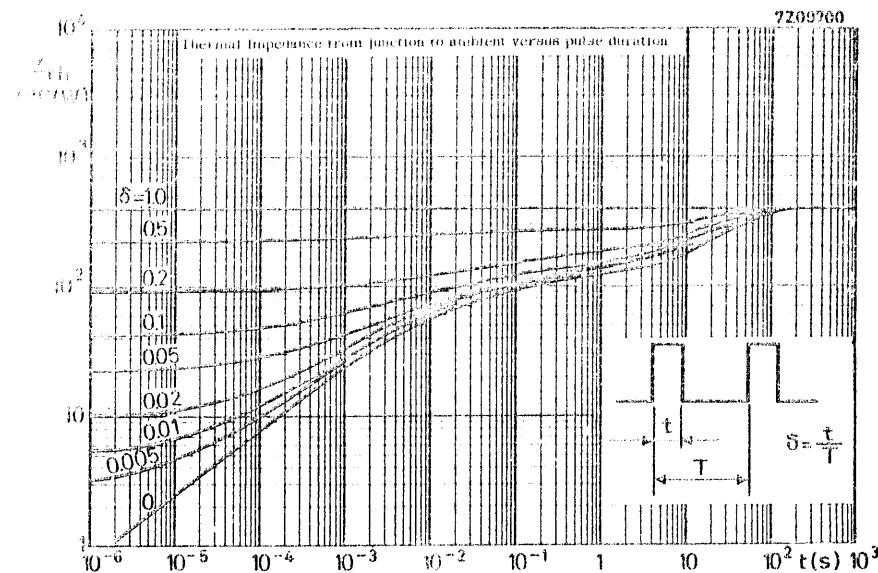




Typical behaviour of base current versus junction temperature







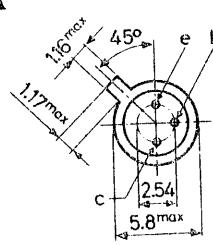
A.F. SILICON PLANAR EPITAXIAL TRANSISTORS

P-N-P transistors in a TO-18 metal envelope with the collector connected to the case. The BC177 is a high voltage type and primarily intended for use in driver stages of audio amplifiers and in signal processing circuits of television receivers. The BC178 is suitable for a multitude of low voltage applications e.g. driver stages or audio pre-amplifiers and in signal processing circuits of television receivers. The BC179 is primarily intended for low noise input stages in tape recorders, hi-fi amplifiers and other audio frequency equipment. Moreover they are intended as complementary types for the BC107, BC108 and BC109.

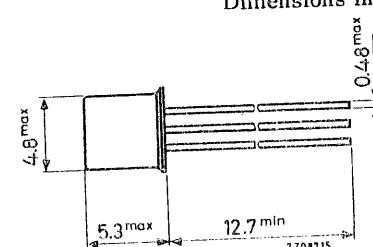
	BC177	BC178	BC179
Collector-emitter voltage ($+V_{BE} = 1$ V)	$-V_{CEX}$ max. 50	30	25 V
Collector-emitter voltage (open base)	$-V_{CEO}$ max. 45	25	20 V
Collector current (peak value)	$-I_{CM}$ max. 200	200	200 mA
Total power dissipation up to $T_{amb} = 25$ °C	P_{tot} max. 300	300	300 mW
Junction temperature	T_j max. 175	175	175 °C
Small signal current gain at $T_j = 25$ °C $-I_C = 2$ mA; $-V_{CE} = 5$ V; $f = 1$ kHz	h_{fe} > 75 < 260	75 500	125 500
Transition frequency at $f = 35$ MHz $-I_C = 10$ mA; $-V_{CE} = 5$ V	f_T typ. 150	150	150 MHz
Noise figure at $R_S = 2$ kΩ $-I_C = 200$ μA; $-V_{CE} = 5$ V $f = 30$ Hz to 15 kHz	F typ. <	10	1.2 dB 4 dB
$f = 1$ kHz; $B = 200$ Hz	F <	10	4 dB

MECHANICAL DATA

TO-18
Collector connected
to case



Dimensions in mm



Accessories available: 56246, 56263

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

Voltages		BC177	BC178	BC179
Collector-base voltage (open emitter)	-V _{CBO}	max.	50	30 25 V
Collector-emitter voltage ($+V_{BE} = 1$ V)	-V _{CEX}	max.	50	30 25 V
Collector-emitter voltage (open base)	-V _{CBO}	max.	45	25 20 V
Emitter-base voltage (open collector)	-V _{EBO}	max.	5	5 5 V

Currents

Collector current (d.c.)	-I _C	max.	100 mA
Collector current (peak value)	-I _{CM}	max.	200 mA
Emitter current (peak value)	I _{EM}	max.	200 mA

Power dissipation

Total power dissipation up to $T_{amb} = 25$ °C	P _{tot}	max.	300 mW
---	------------------	------	--------

Temperatures

Storage temperature	T _{stg}	-65 to +175	°C
Junction temperature	T _j	max.	175 °C

THERMAL RESISTANCE

From junction to ambient in free air	R _{th j-a}	=	0.5 °C/mW
From junction to case	R _{th j-c}	=	0.2 °C/mW

CHARACTERISTICSCollector cut-off current

→ I _E = 0 ; -V _{CB} = 20 V; T _j = 25 °C T _j = 150 °C	-I _{CBO}	typ.	1 nA
	-I _{CBO}	<	100 nA 10 μA

Base-emitter voltage 1)

-I _C = 2 mA; -V _{CE} = 5 V; T _j = 25 °C	-V _{BE}	typ.	650 mV
			600 to 750 mV

CHARACTERISTICS (continued)

D.C. current gain	BC177	BC178A BC179A	BC178B BC179B
-I _C = 2 mA; -V _{CE} = 5 V	h _{FE}	typ. 140	180 290
Small signal current gain at f = 1 kHz -I _C = 2 mA; -V _{CE} = 5 V	h _{FE}	> 75 < 260	125 240 260 500

1) -V_{BE} decreases by about 2 mV/°C with increasing temperature.

CHARACTERISTICS (continued) $T_j = 25^\circ\text{C}$ unless otherwise specifiedSaturation voltages $-I_C = 10 \text{ mA}; -I_B = 0.5 \text{ mA}$

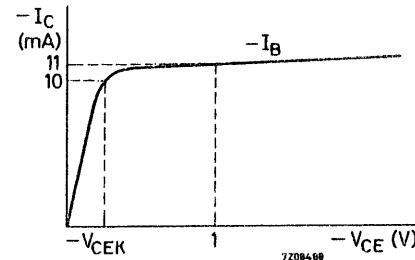
$-V_{CEsat}$	typ.	75 mV	→
$-V_{BEsat}$	<	300 mV	→
$-V_{CEsat}$	typ.	700 mV	
$-V_{BEsat}$	typ.	250 mV	→

 $I_C = 100 \text{ mA}; I_B = 5 \text{ mA}$

$-V_{CEsat}$	typ.	250 mV	→
$-V_{BEsat}$	typ.	850 mV	→

Knee voltage

$-I_C = 10 \text{ mA}; -I_B = \text{value for which}$
 $-I_C = 11 \text{ mA at } -V_{CE} = 1 \text{ V}$



$-V_{CEK}$	typ.	250 mV	→
$-V_{CEK}$	<	600 mV	

Collector capacitance at $f = 1 \text{ MHz}$ $I_E = I_e = 0; -V_{CB} = 10 \text{ V}$

C_C	typ.	4.0 pF	→
-------	------	--------	---

Transition frequency at $f = 35 \text{ MHz}$ $-I_C = 10 \text{ mA}; -V_{CE} = 5 \text{ V}$

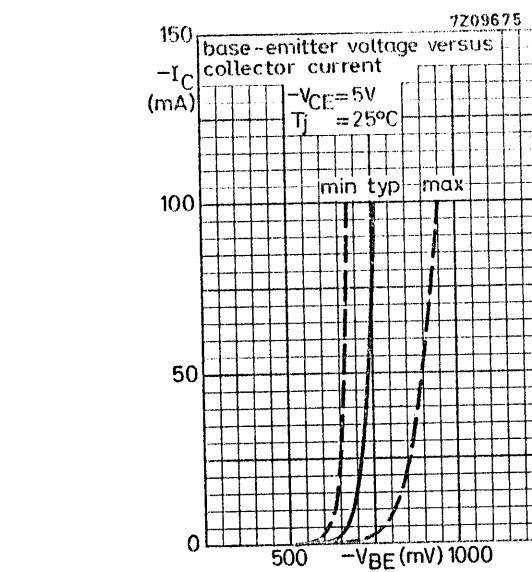
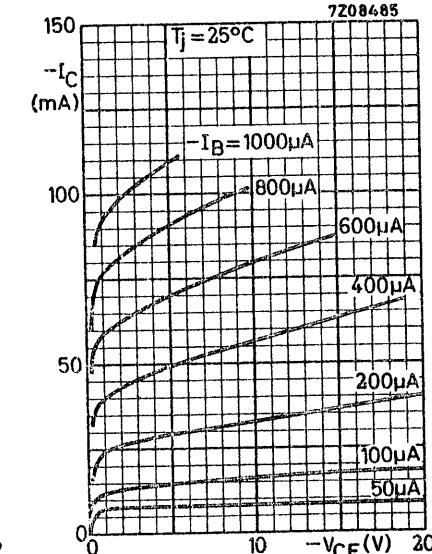
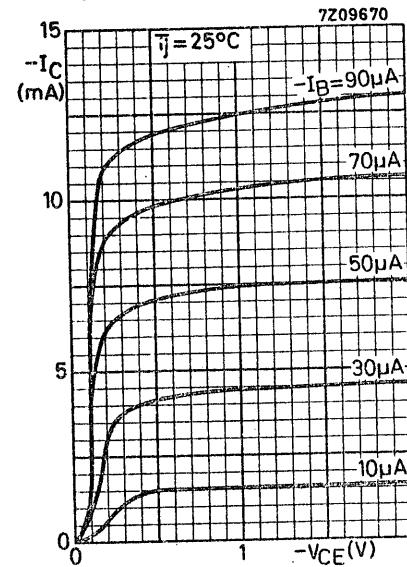
f_T	typ.	150 MHz	→
-------	------	---------	---

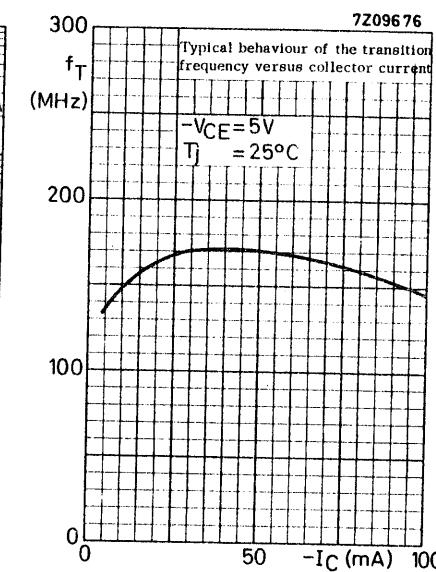
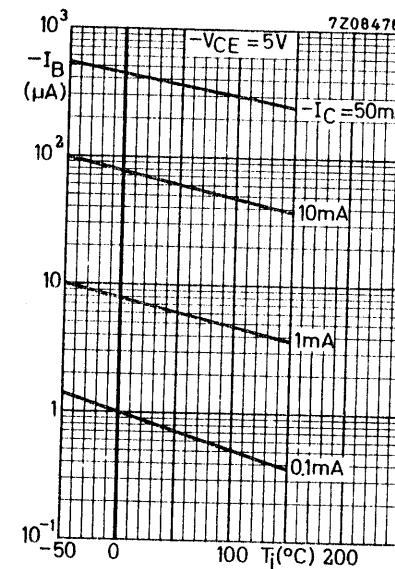
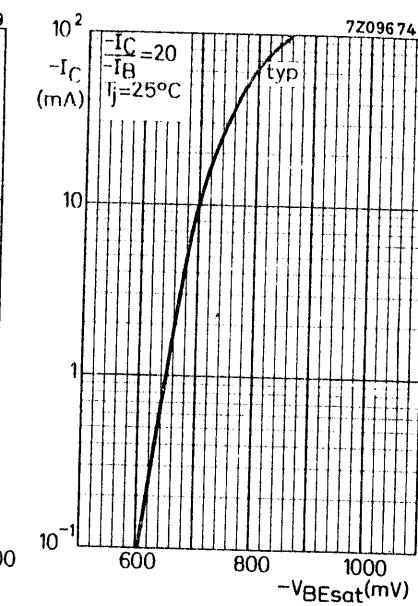
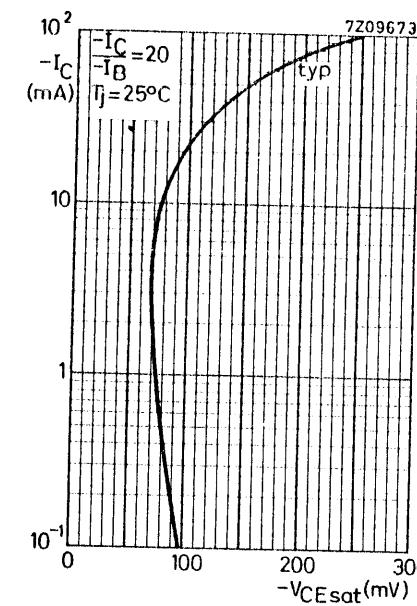
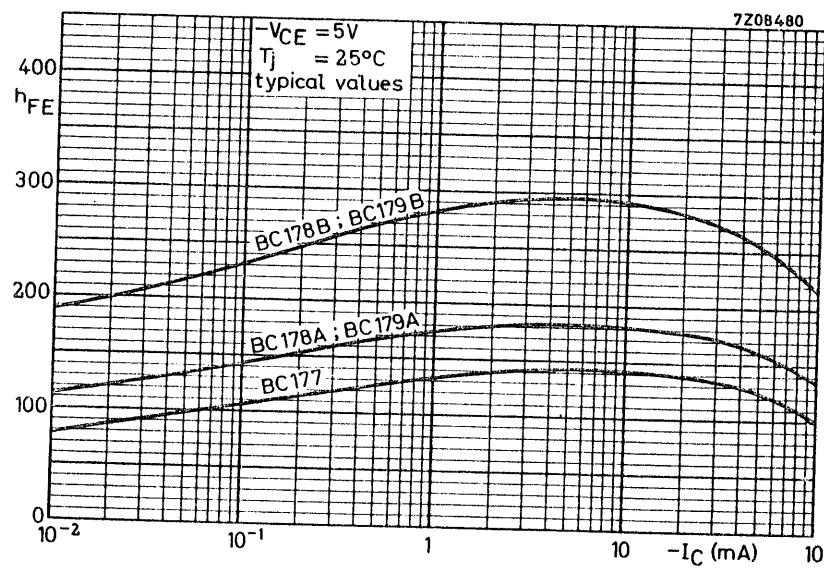
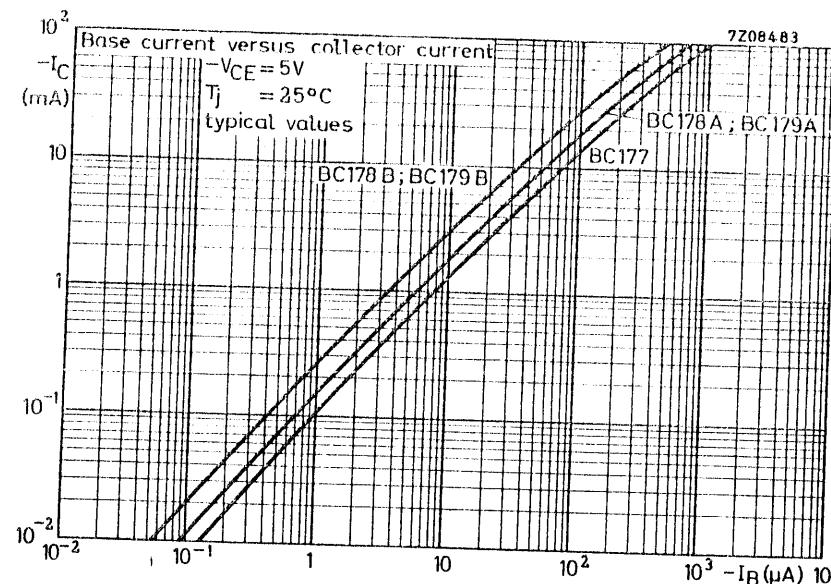
Small signal current gain at $f = 1 \text{ kHz}$ $-I_C = 2 \text{ mA}; -V_{CE} = 5 \text{ V}$

	BC177	BC178	BC179
h_{fe}	> 75	75	125
	< 260	500	500

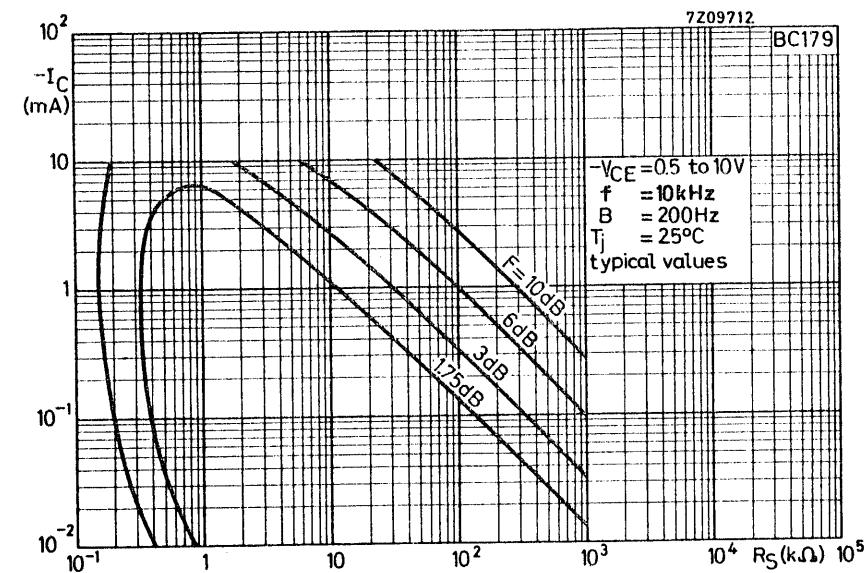
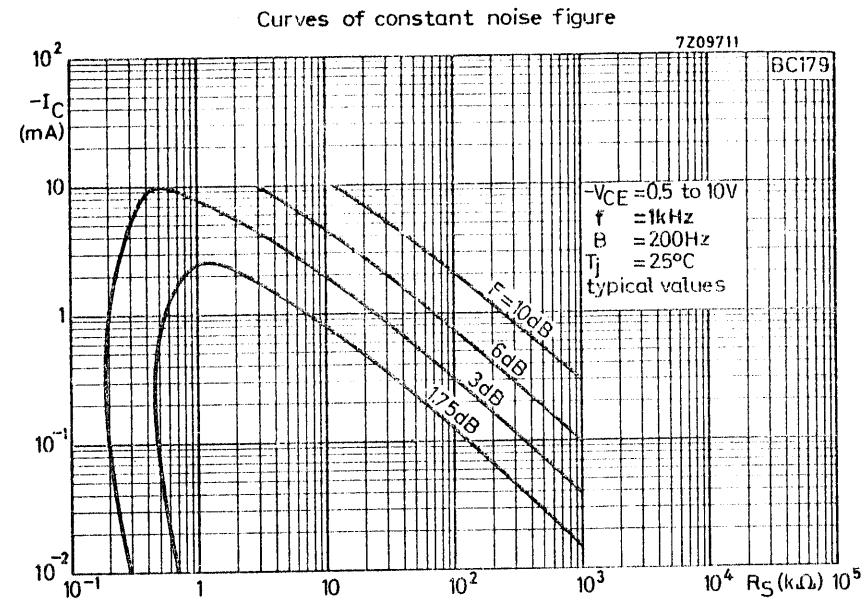
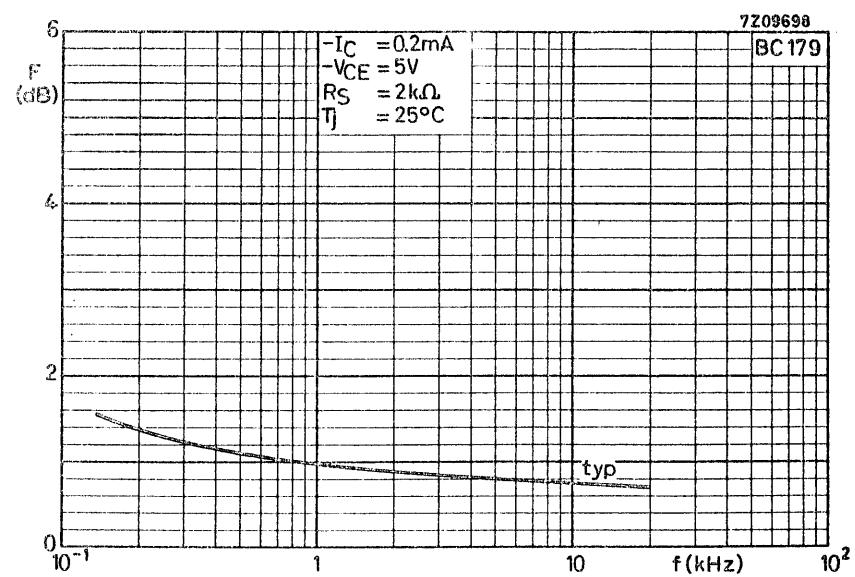
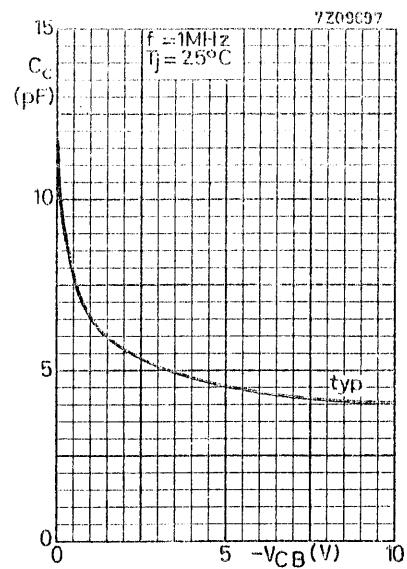
Noise figure at $R_S = 2 \text{ k}\Omega$ $-I_C = 200 \mu\text{A}; -V_{CE} = 5 \text{ V}$ $f = 30 \text{ Hz to } 15 \text{ kHz}$

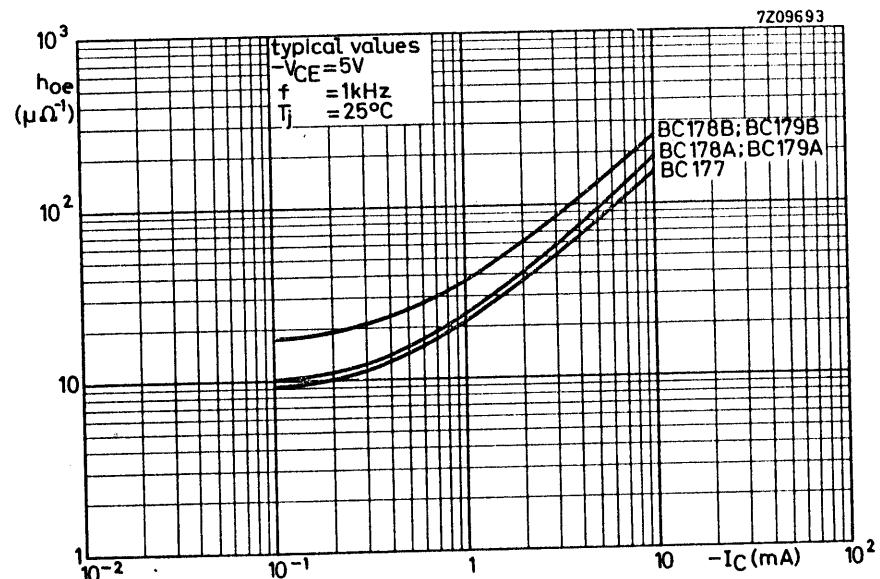
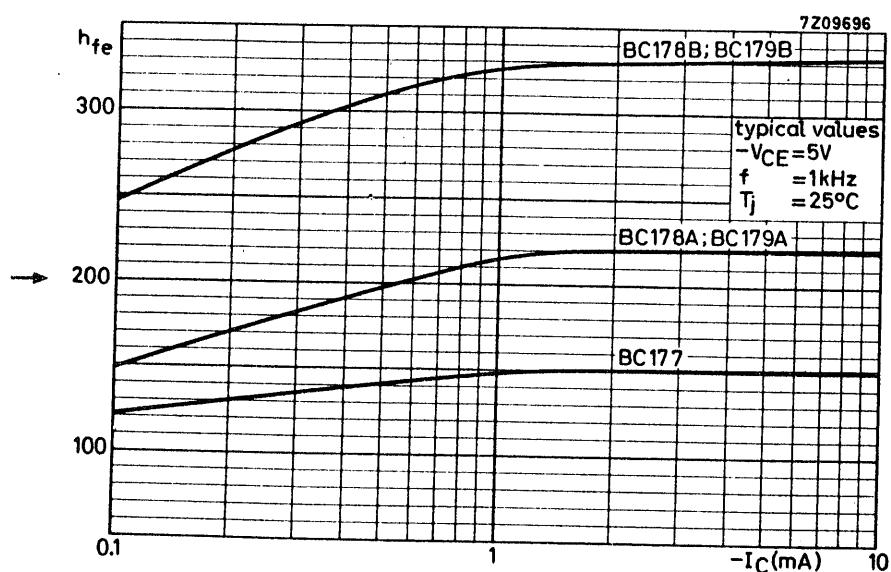
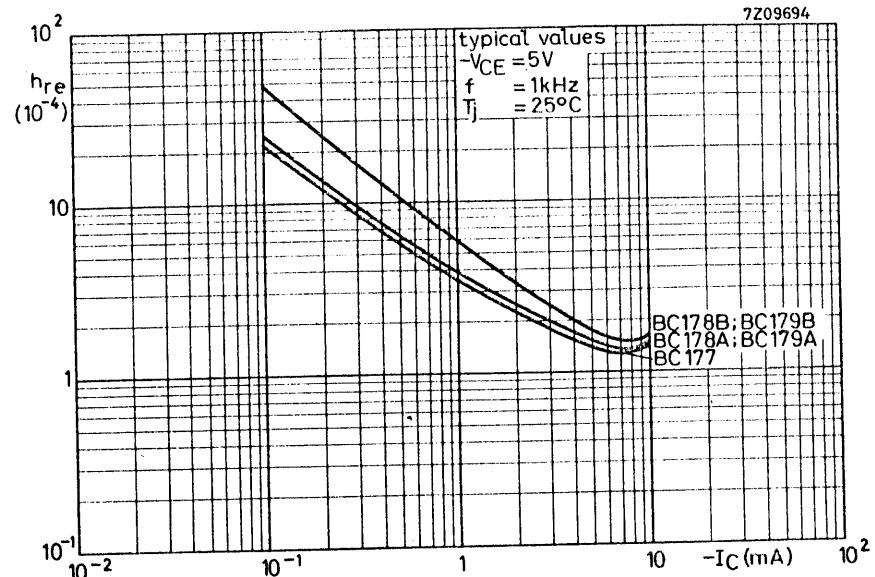
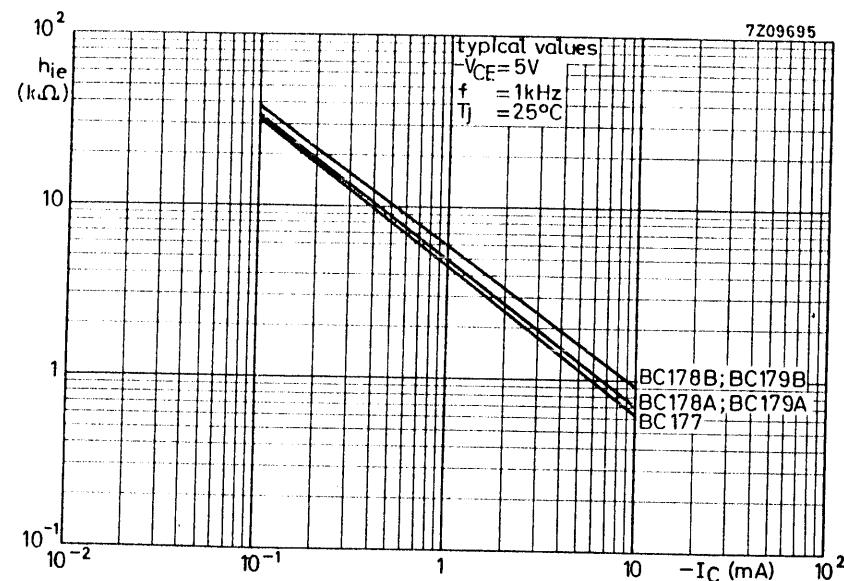
F	typ.	1.2 dB	→
	<	4 dB	
F	typ.	1 dB	→
	< 10	4 dB	→

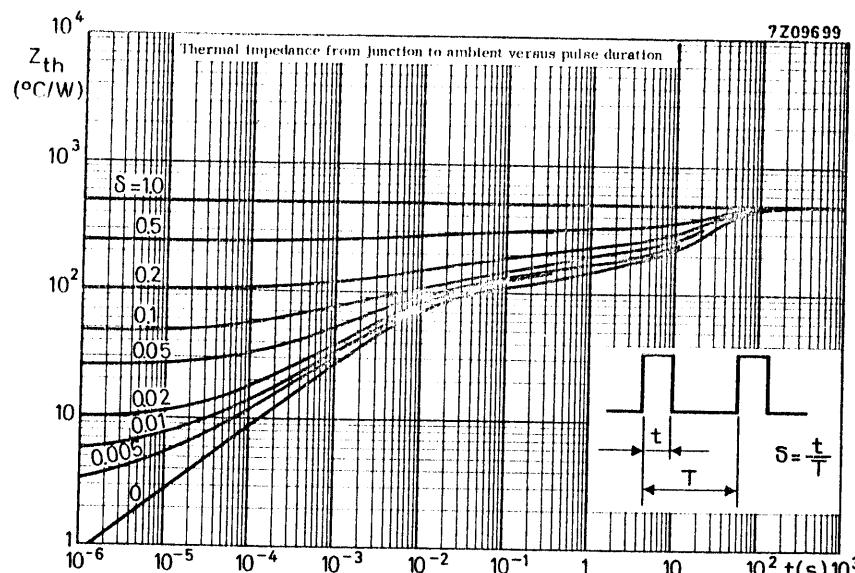
 $f = 1 \text{ kHz}; B = 200 \text{ Hz}$ Typical behaviour of collector current versus collector-emitter voltage



Typical behaviour of base current versus junction temperature







HIGH VOLTAGE SILICON TRANSISTOR

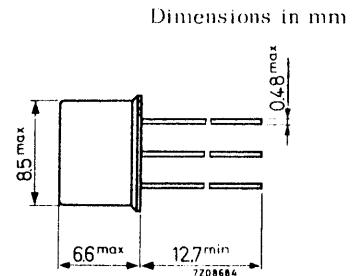
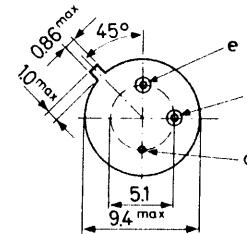
N-P-N silicon planar transistor in a TO-39 metal envelope with the collector connected to the case.

The transistor is intended for use in high voltage 2 W class A output stages of a.f. amplifiers, video amplifiers in colour television receivers including grid drive and in driver stages of high voltage line-deflection circuits.

QUICK REFERENCE DATA			
Collector-base voltage (open emitter)	V_{CBO}	max.	220 V
Collector-emitter voltage (open base)	V_{CEO}	max.	180 V
Collector current (peak value)	I_{CM}	max.	150 mA
Total power dissipation up to $T_{amb} = 50^\circ\text{C}$ (device mounted on a heatsink)	P_{tot}	max.	6 W
D.C. current gain at $T_j = 25^\circ\text{C}$ $I_C = 50 \text{ mA}; V_{CE} = 100 \text{ V}$	h_{FE}	> typ.	22 60

MECHANICAL DATA

Collector connected
to case
TO-39



Dimensions in mm

Accessories available: 56218; 56245; 56265

RATINGS (Limiting values)¹⁾Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	220	V	²⁾
Collector-emitter voltage (open base) (See also page 4)	V_{CEO}	max.	180	V	
Collector-emitter voltage with $R_{BE} \leq 1 \text{ k}\Omega$	V_{CER}	max.	220	V	²⁾
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V	

Currents

Collector current (d.c.)	I_C	max.	150	mA
Collector current (peak value)	I_{CM}	max.	150	mA

Power dissipation

Total power dissipation up to $T_{amb} = 50^\circ\text{C}$ mounted on a 1.5 mm Al. blackened heatsink of at least 30 cm ² (See also page 4)	P_{tot}	max.	6	W
--	-----------	------	---	---

Temperatures

Storage temperature	T_{stg}	-55 to +200	$^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th j-a}$	=	200	$^\circ\text{C/W}$
From junction to mounting base	$R_{th j-mb}$	=	12.5	$^\circ\text{C/W}$
From junction to ambient mounted on a 1.5 mm blackened aluminium heatsink of at least 30 cm ²	$R_{th j-a}$	=	25	$^\circ\text{C/W}$

¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

→ 2) During switching on, a supply voltage of 1.2 times the rated V_{CER} value is permitted. The current must be limited so that maximum dissipation and maximum junction temperature are not exceeded.

CHARACTERISTICS

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

Collector cut-off current

$I_E = 0$; $V_{CB} = 200$ V; $T_j = 200^\circ\text{C}$ I_{CBO} typ. 550 μA

Emitter cut-off current

$I_C = 0$; $V_{EB} = 5$ V I_{EBO} < 100 μA

Base-emitter voltage¹⁾

$I_C = 50$ mA; $V_{CE} = 100$ V V_{BE} < 1 V

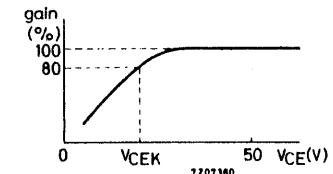
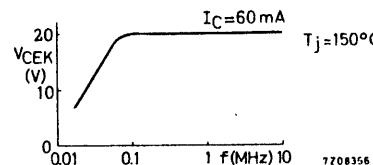
Saturation voltage

$I_C = 100$ mA; $I_B = 10$ mA V_{CESat} typ. 6.5 V
< 9 V

High frequency knee voltage at $T_j = 150^\circ\text{C}$

$I_C = 60$ mA V_{CEK} typ. 20 V

The high frequency knee voltage of a transistor is that value of the collector-emitter voltage at which the small signal gain, measured in a practical circuit, has dropped to 80% of the gain at $V_{CE} = 50$ V. A further decrease of the collector-emitter voltage results in a rapid increase of the distortion of the signal.

D.C. current gain

$I_C = 50$ mA; $V_{CE} = 100$ V h_{FE} > 22 typ. 60

Ratio of h_{FE} at $I_C = 100$ mA; $V_{CE} = 15$ V
and at $I_C = 10$ mA; $V_{CE} = 165$ V typ. 1.1

Feedback capacitance

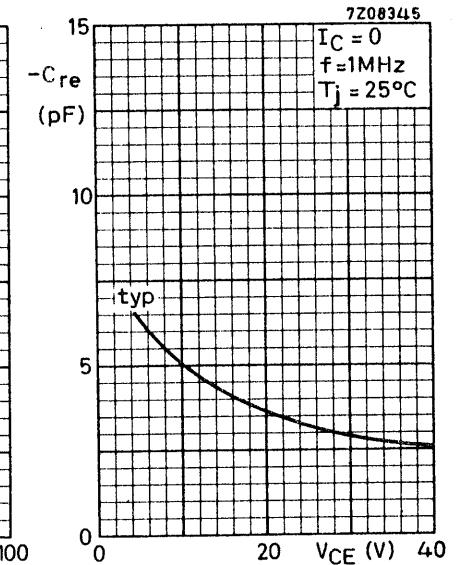
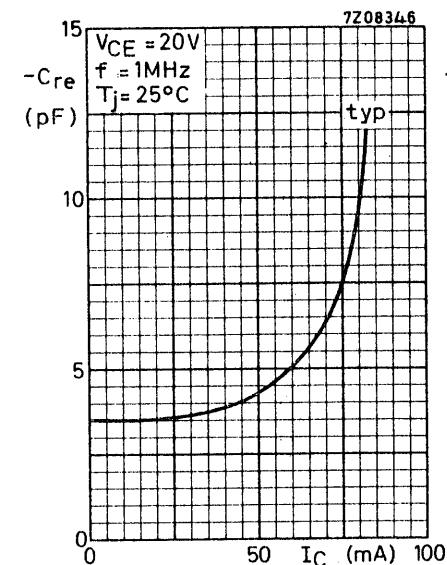
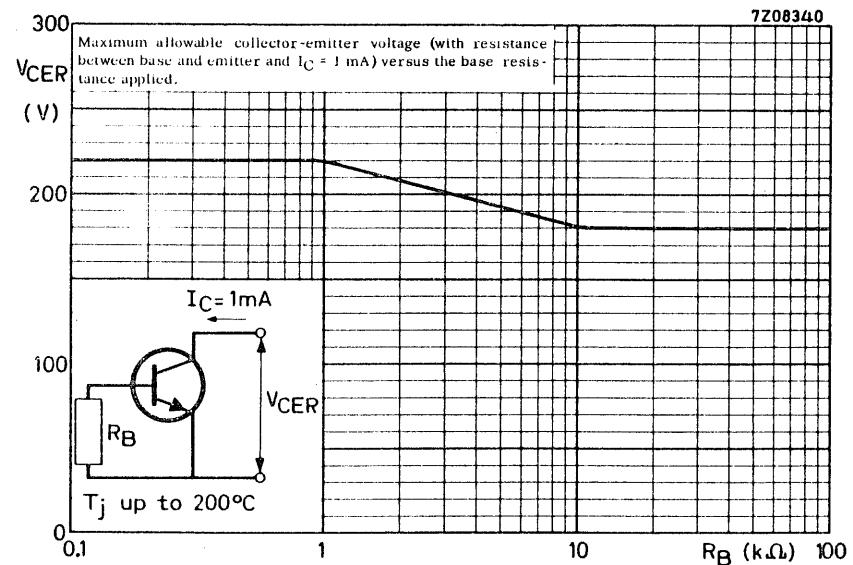
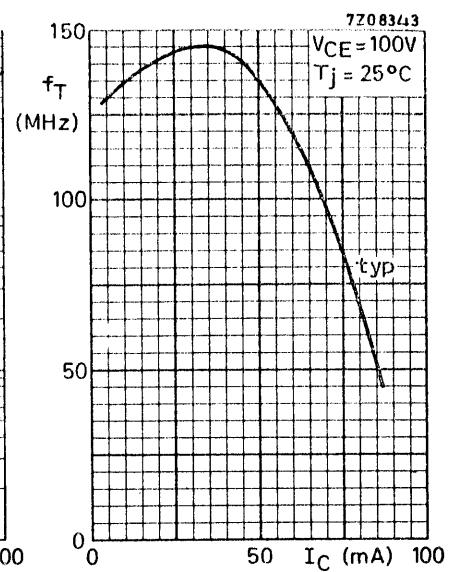
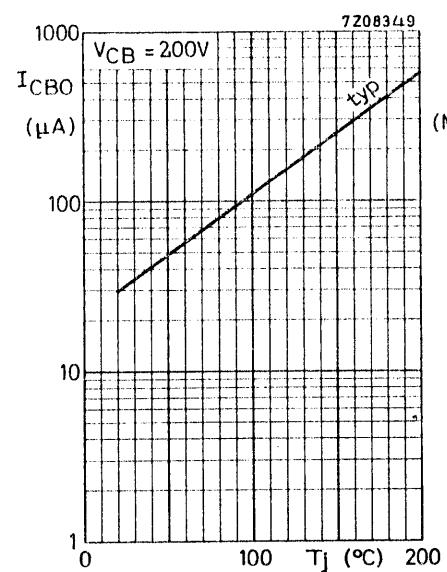
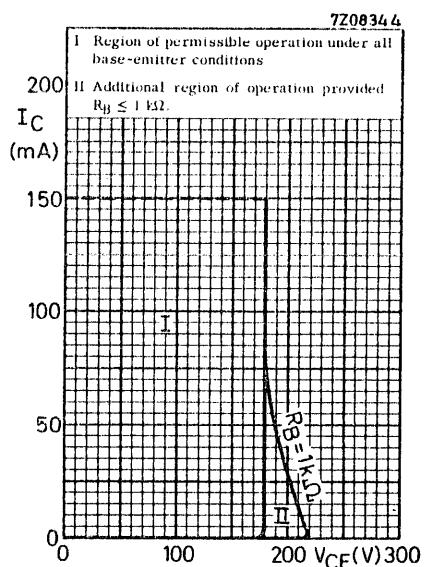
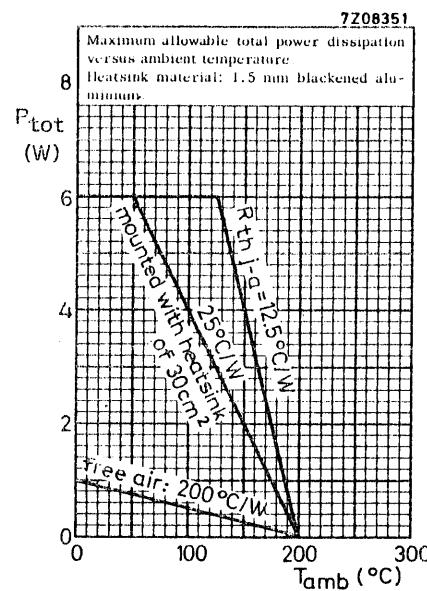
$I_C = 10$ mA; $V_{CE} = 20$ V; $f = 1.0$ MHz $-C_{re}$ typ. 3.5 pF

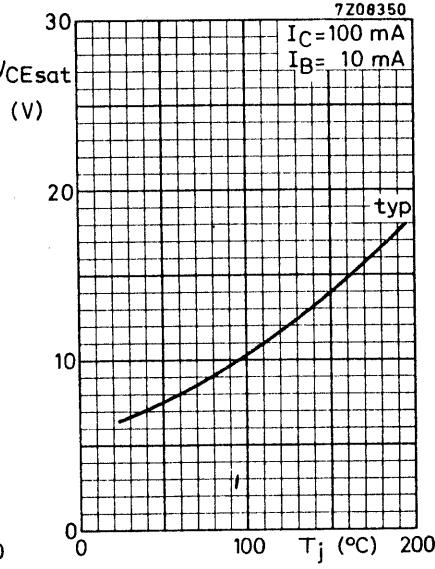
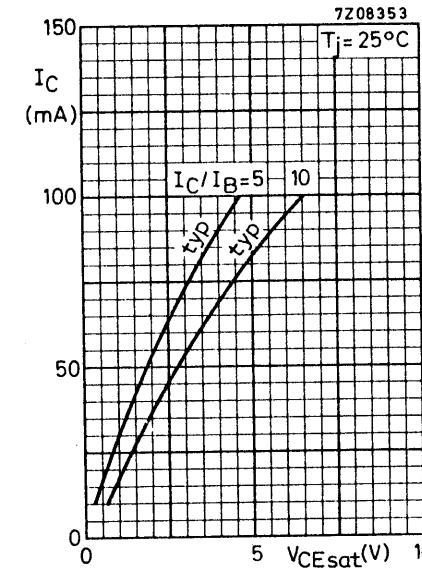
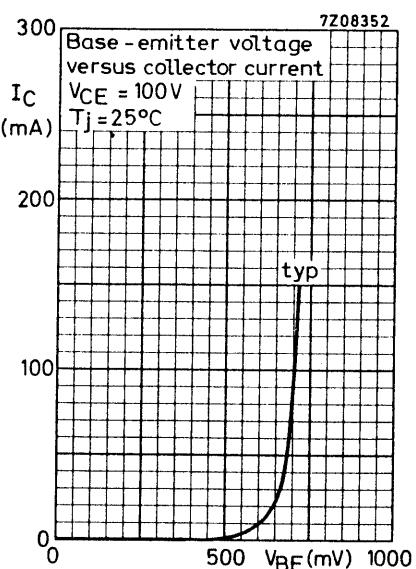
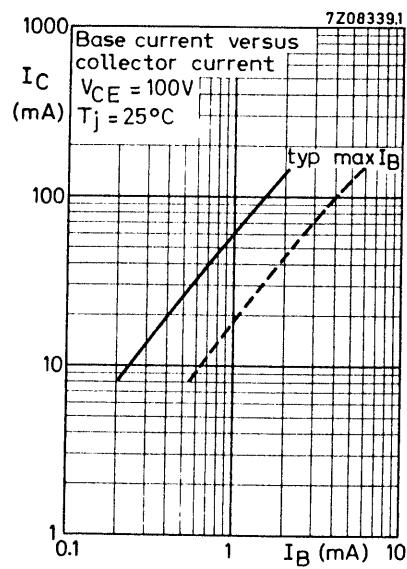
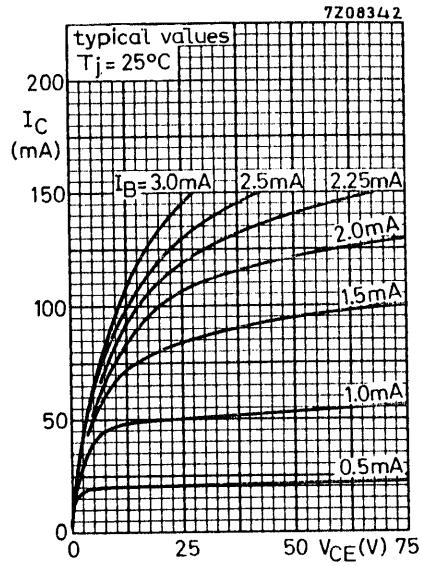
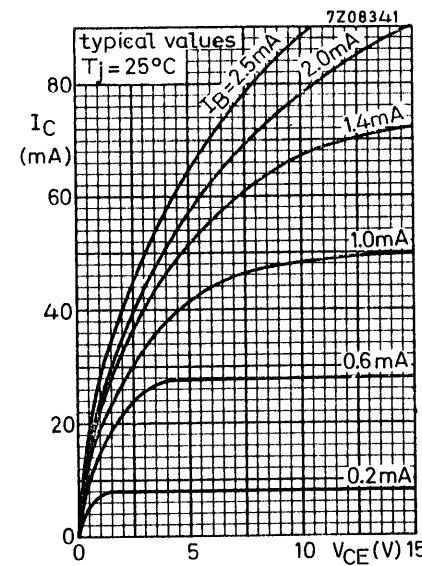
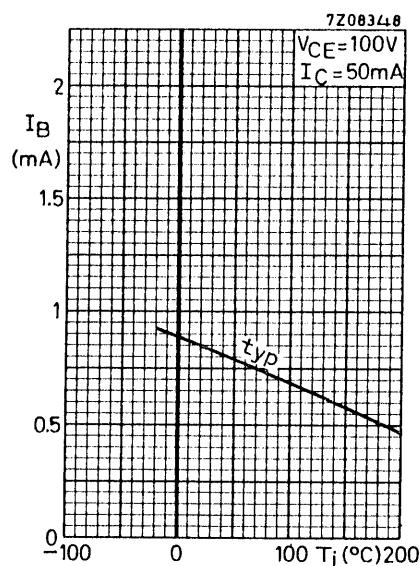
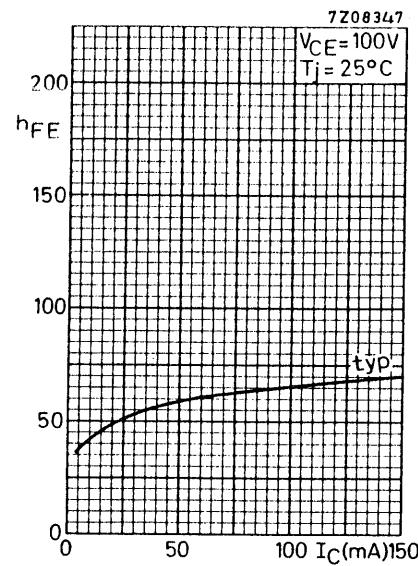
Feedback time constant
 $-I_E = 10$ mA; $V_{CB} = 10$ V; $f = 10$ MHz $r_{bb}C_{bb'}$ typ. 30 ps
< 100 ps

Transition frequency

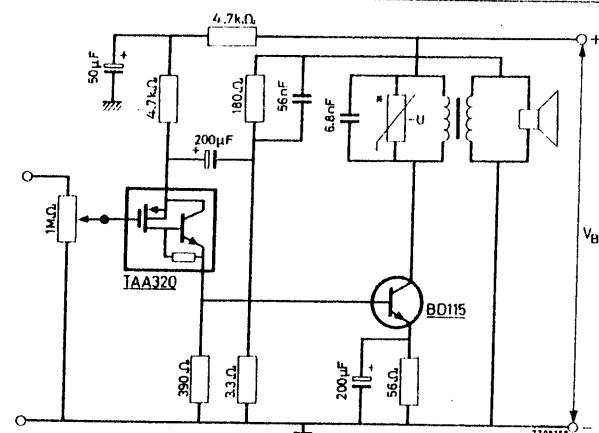
$I_C = 30$ mA; $V_{CE} = 100$ V f_T typ. 145 MHz

¹⁾ V_{BE} decreases by about 2 mV/ $^\circ\text{C}$ with increasing temperature.





APPLICATION INFORMATION 2 W audio amplifier with TAA320 and BD115



(* The voltage dependent resistor (2322 552 03381) suppresses voltage transients that might otherwise exceed the safe operating limits of the BD115.)

Supply voltage	V_B	100	V
Collector current of BD115	I_C	typ.	50 mA
Drain current of TAA320	$-I_D$	typ.	9.5 mA
Primary d.c. resistance of output transformer		140	Ω
Primary inductance of output transformer		2.7	H
A.C. collector load for BD115		1.8	k Ω
Performance at $f = 1$ kHz; feedback = 16 dB			
Output power at $d_{tot} = 10\%$ (on primary of the output transformer)	P_o	typ.	2.6 W
Input voltage for $P_o = 50$ mW	$V_i(rms)$	typ.	13.5 mV
Input voltage for $P_o = 2$ W	$V_i(rms)$	typ.	86 mV
Total distortion at $P_o = 2$ W	d_{tot}	typ.	3.6 %
Frequency response (-3 dB)		60 Hz to 20	kHz
Signal-noise ratio at $P_o = 2$ W		typ.	73 dB
Mounting instruction for BD115			

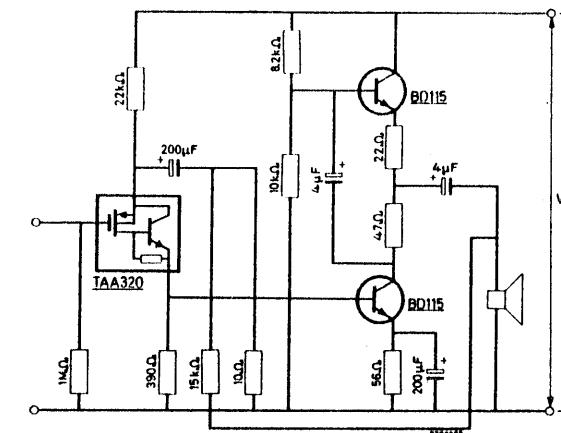
Proper continuous operation is ensured up to $T_{amb} = 50$ °C, provided the BD115 is directly mounted on a 1.5 mm blackened Al. heatsink of 30 cm^2 with a clamping washer of type 56218.

If the transistor is mounted on a heatsink with a mica washer, the heatsink should have an area of 50 cm^2 .

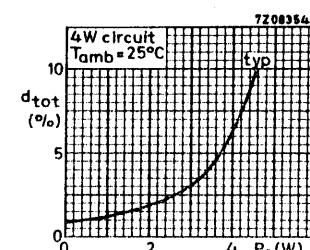
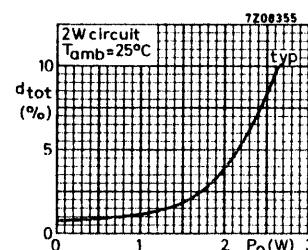
Recommended diameter of hole in heatsink: 7.7 mm.

APPLICATION INFORMATION (continued)

4 W audio amplifier with TAA320 and 2 transistors of type BD115.



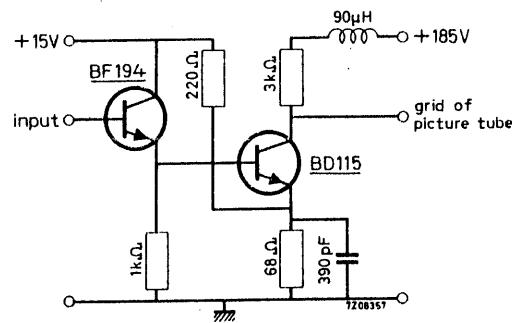
Supply voltage	V_B	200	V
Collector current of a BD115	I_C	typ.	52 mA
Drain current of TAA320	$-I_D$	typ.	8.6 mA
Performance at $f = 1$ kHz; feedback = 12 dB			
Output power at $d_{tot} = 10\%$	P_o	typ.	4.5 W
Input voltage for $P_o = 50$ mW	$V_i(rms)$	typ.	7.5 mV
Input voltage for $P_o = 4$ W	$V_i(rms)$	typ.	67 mV
Total distortion at $P_o = 4$ W	d_{tot}	typ.	6 %
Frequency response (-3 dB)		50 Hz to 20	kHz
Signal-noise ratio at $P_o = 4$ W		typ.	73 dB
Mounting instruction for BD115 see page 8			



APPLICATION INFORMATION (continued)

Grid-driver circuit for colour picture tubes.

Three identical circuits are used for the red, green and blue signal respectively.



Performance up to $T_{amb} = 55^{\circ}\text{C}$

Voltage gain	G_V	60
Output voltage (video information) (peak-peak)	V_o	120 V
	$V_o(p-p)$	150 V
Bandwidth (-3 dB)		> 4 MHz
Rise time	t_r	< 80 ns
Overshoot		< 5 %

Note

1. The maximum dissipation of the output transistor is 3.3 W. In order not to exceed the junction temperature rating, the thermal resistance from junction to ambient should be: $R_{th j-a} < 45^{\circ}\text{C/W}$. To ensure the above mentioned performance for bandwidth and transient response, the contribution of the heatsink to the total output capacitance of the device should not exceed 4 pF.
2. For grid drive of the picture tube, the sync pulses must be negative going. To avoid driving the output transistor into the high frequency knee voltage, the sync pulses must be clipped before the output stage.

SILICON PLANAR EPITAXIAL POWER TRANSISTOR

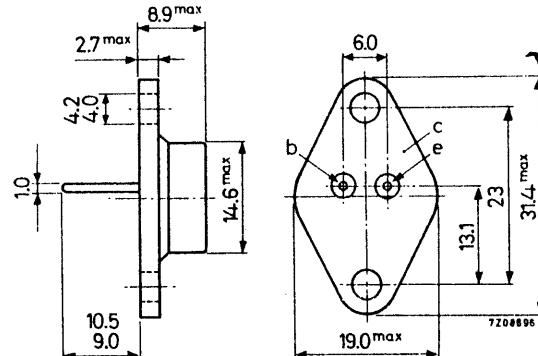
N-P-N silicon power transistor in a metal envelope with the collector connected to the case. It is primarily intended for quasi-complementary output stages up to 15 W in audio applications, such as hi-fi amplifiers.

QUICK REFERENCE DATA	
Collector-base voltage (open emitter)	V_{CBO} max. 70 V
Collector-emitter voltage (open base)	V_{CEO} max. 45 V
Collector current (peak value)	I_{CM} max. 4.0 A
Total power dissipation up to $T_{mb} = 62.5^{\circ}\text{C}$	P_{tot} max. 15 W
D.C. current gain $I_C = 2 \text{ A}; V_{CE} = 5 \text{ V}$	hFE > 25 typ. 50
Transition frequency at $f = 35 \text{ MHz}$ $I_C = 250 \text{ mA}; V_{CE} = 5 \text{ V}$	f_T typ. 120 MHz

MECHANICAL DATA

Dimensions in mm

Collector connected to the case



Accessories available: 56203

RATINGS (Limiting values)¹⁾Voltages

Collector-base voltage (open emitter)

V_{CBO} max. 70 VCollector-emitter voltage (open base)²⁾V_{CEO} max. 45 V

Emitter-base voltage (open collector)

V_{EB0} max. 6.0 VCurrents

Collector current (d.c. and average)

I_C max. 2.0 A

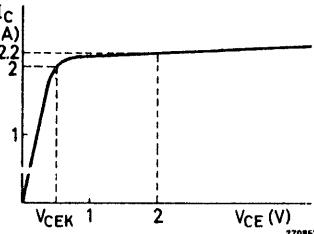
Collector current (peak value)

I_{CM} max. 4.0 ANon repetitive peak overload current³⁾at V_{CE} = 7 V; t = 1 msI_{CSM} max. 5 AV_{CE} = 20 V; t = 100 μ sI_{CSM} max. 5 AV_{CE} = 35 V; t = 10 μ sI_{CSM} max. 4 A

Emitter current (peak value)

-I_{EM} max. 4.0 APower dissipationTotal power dissipation up to T_{mb} = 62.5 °C

(see also page 4 and 5)

P_{tot} max. 15 W**CHARACTERISTICS**T_j = 25 °C unless otherwise specifiedCollector cut-off currentI_E = 0; V_{CB} = 45 VI_{CBO} typ. 0.5 μ A
< 2 μ AEmitter cut-off currentI_C = 0; V_{EB} = 5 VI_{IEBO} typ. 0.1 μ A
< 2 μ ABase-emitter voltage¹⁾I_C = 50 mA; V_{CE} = 5 VV_{BE} typ. 0.7 VI_C = 2 A; V_{CE} = 5 VV_{BE} typ. 1.0 VKnee voltageI_C = 2 A; I_B = value for whichI_C = 2.2 A at V_{CE} = 2 VV_{CEK} typ. 1.0 V
< 1.9 VD.C. current gainI_C = 50 mA; V_{CE} = 5 VhFE typ. 25
> 60I_C = 0.5 A; V_{CE} = 5 VhFE typ. 35
> 75I_C = 2 A; V_{CE} = 5 VhFE typ. 25
> 50Collector capacitance at f = 1 MHzI_E = I_e = 0; V_{CB} = 10 VC_c typ. 55 pFTransition frequency at f = 35 MHzI_C = 250 mA; V_{CE} = 5 Vf_T typ. 120 MHz**MATCHING CHARACTERISTICS**Base current differenceI_C = 0.5 A; V_{CE} = 5 V|I_{B1}-I_{B2}| < 2 mAResulting ratio of d.c. current gain

for low gain devices

< 1.2

for typical gain devices

< 1.3

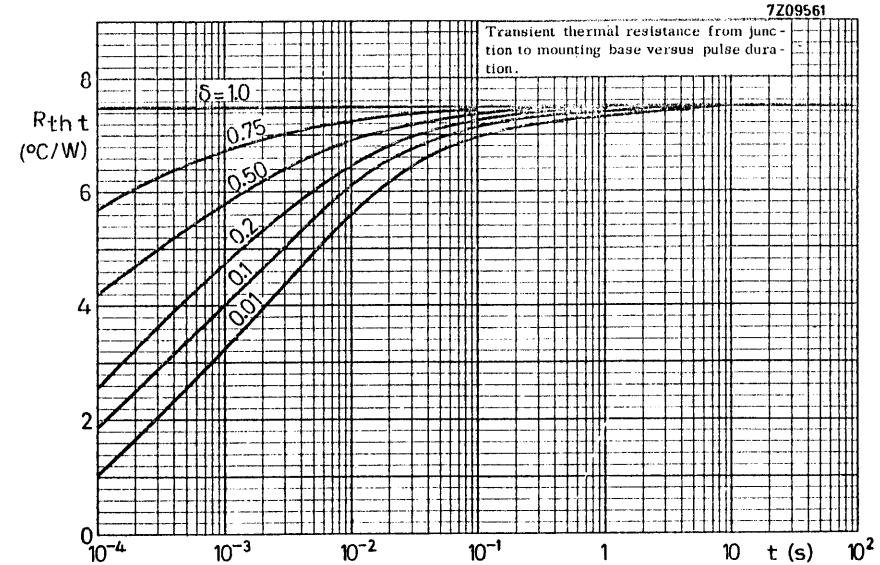
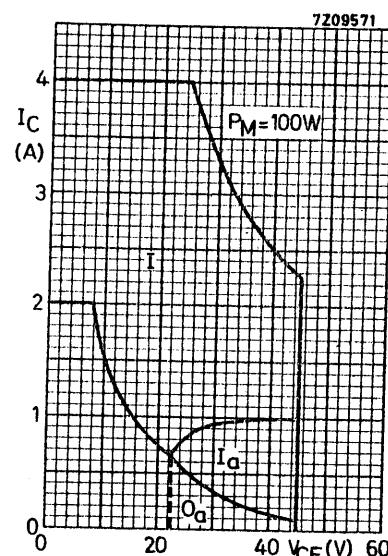
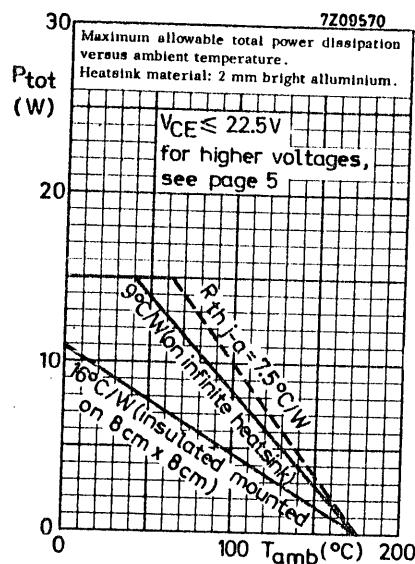
for high gain devices

< 1.5

1) V_{BE} decreases by about 1.6 mV/°C with increasing temperature.

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

2) At I_C = 200 mA.3) Prior to non repetitive peak overload current: T_j = 175 °C



Region I: $\Delta T_{j-mb} = T_j \text{ peak} - T_{mb} \text{ max. } 115^{\circ}\text{C}$

Make use of transient thermal resistance graph on page 5.

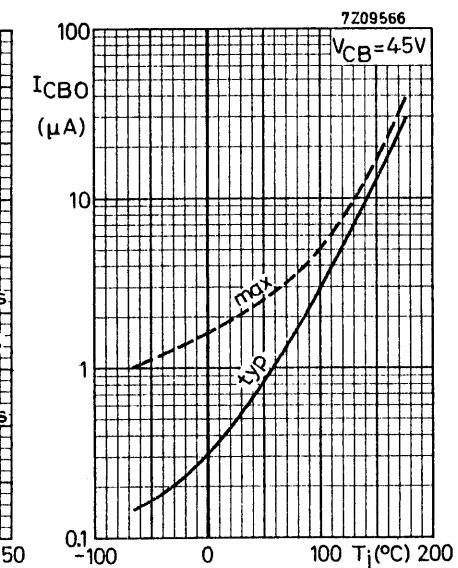
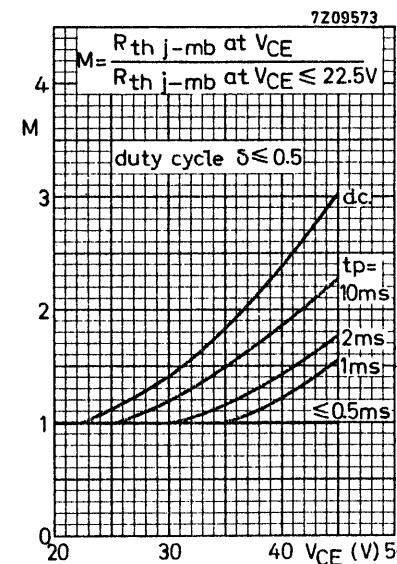
Regions O_a and I_a

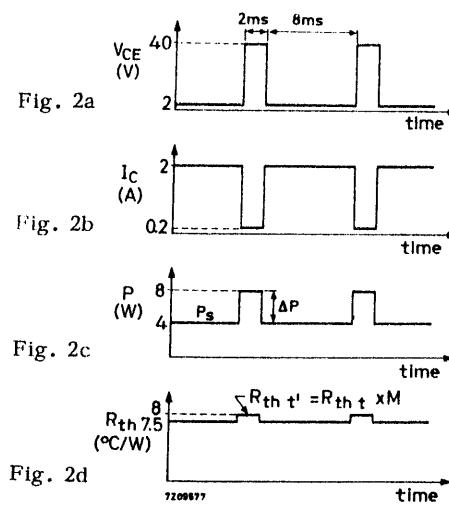
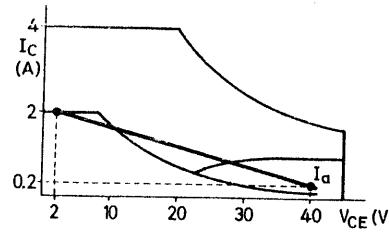
To prevent damage due to second breakdown effects, transistors may only be operated in these regions if the increased thermal resistance at higher voltages is taken into account.

Region O_a: The steady state value of the thermal resistance from junction to mounting base should be multiplied by factor M taken from lower graph left hand side on page 5.

Region I_a: $\Delta T_{j-mb} \text{ max. } 115^{\circ}\text{C}$

Dependent on voltage, pulse time and duty cycle, the transient thermal resistance value from junction to mounting base should be multiplied by factor M taken from lower graph left hand side on page 5.





Calculation example

Suppose a transistor is used in a switching circuit with a resistive load (fig. 1) and is switched from conditions 2V-2A to 40V-0.2A with a pulse duration $t_p = 2 \text{ ms}$ and a duty cycle $\delta = 0.2$.

The collector-emitter voltage, the collector current and the power dissipation as a function of time are shown in figs. 2a, 2b and 2c.

From fig. 1 it follows that 4 W is continuously dissipated. This is plotted in fig. 2c. Peak dissipations of 8 W occur in region Ia.

In fig. 2d the appropriate thermal resistance values are indicated.

The peak junction temperature is given by:

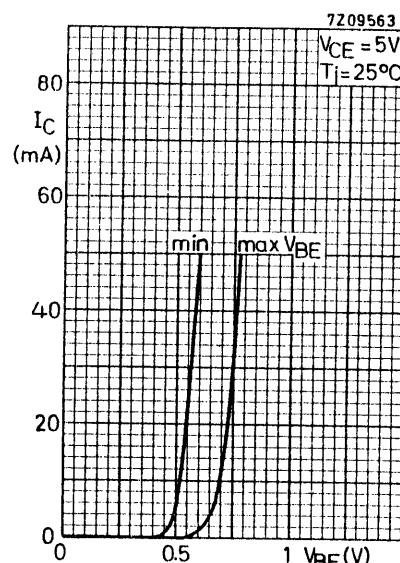
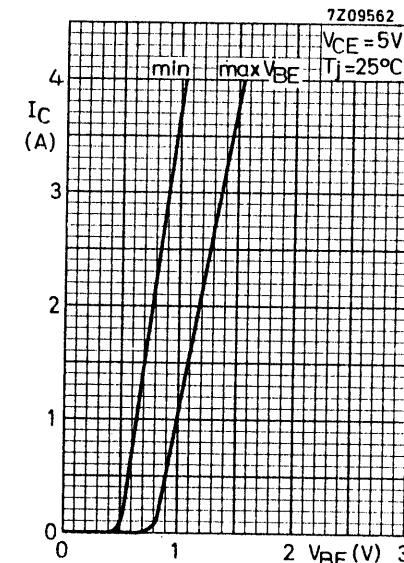
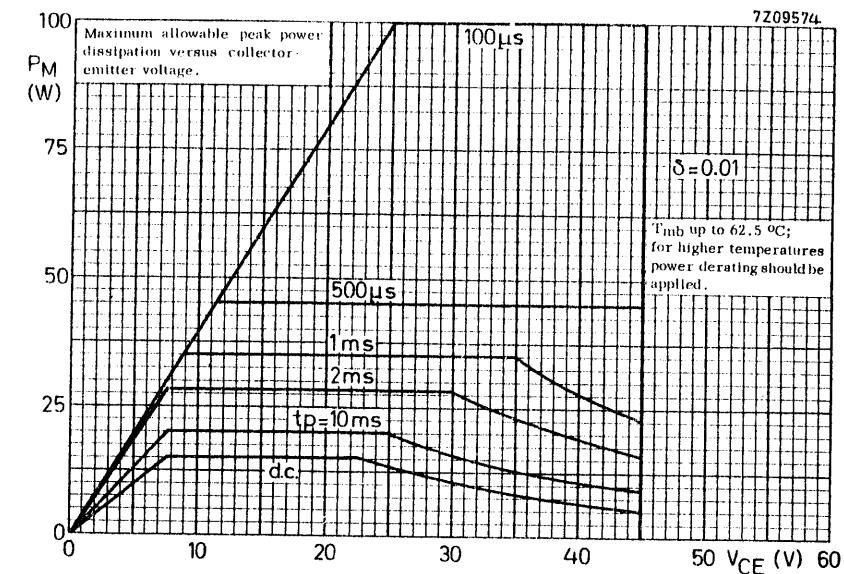
$$\begin{aligned} T_{j \text{ peak}} &= T_{mb} + P_s \times R_{th j-mb} + R_{th t'} \times \Delta P^{-1} \\ &= T_{mb} + 4 \times 7.5 + 8 \times 4 \\ &= T_{mb} + 30 + 32 \\ &= T_{mb} + 62 \end{aligned}$$

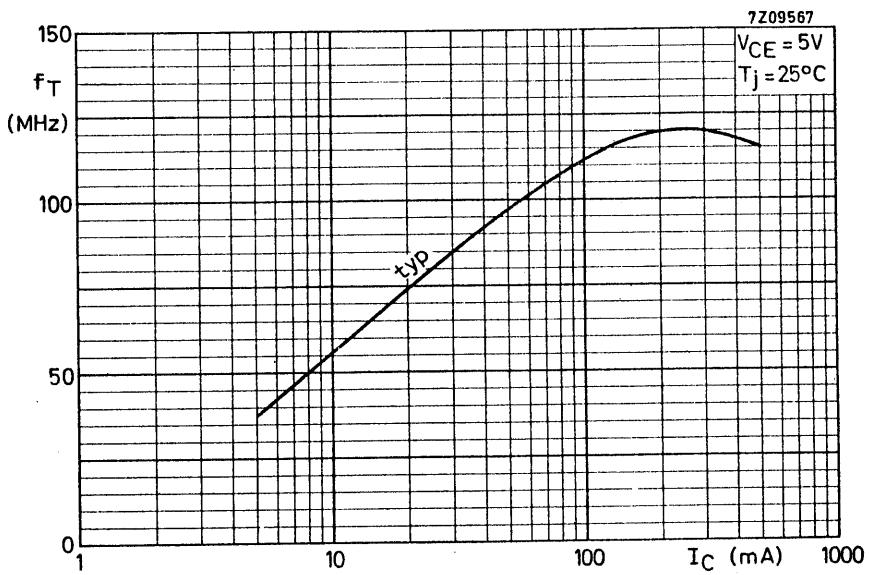
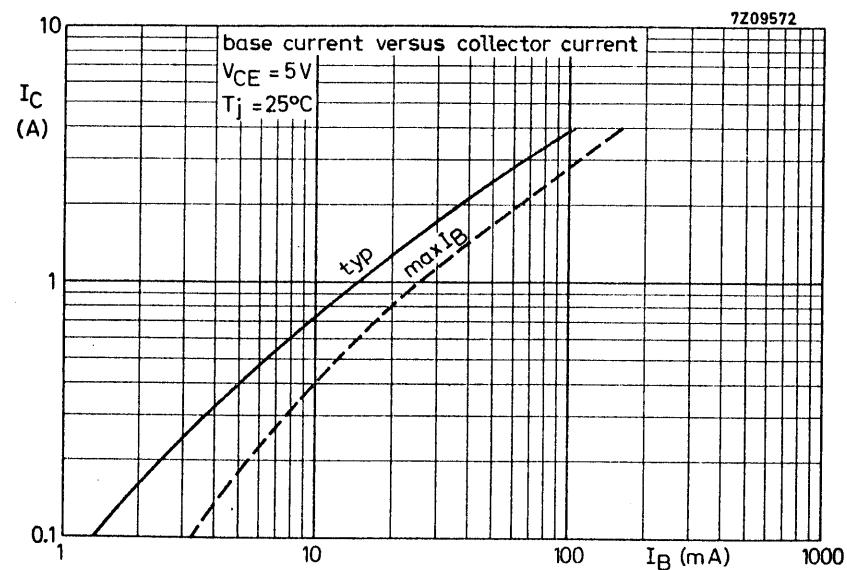
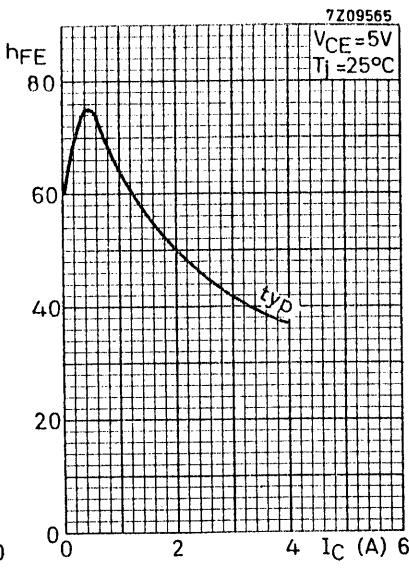
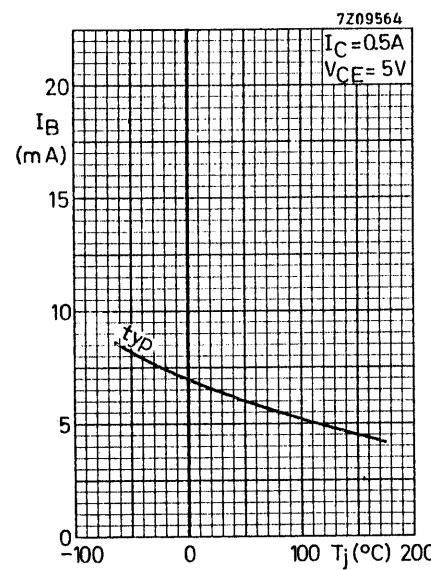
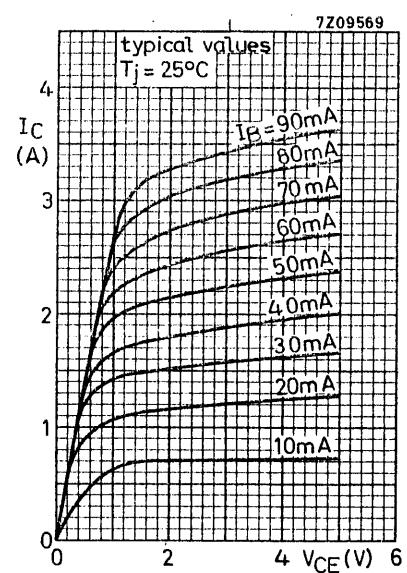
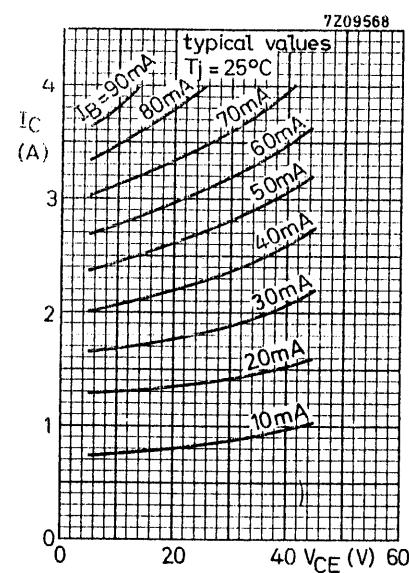
$$T_{j \text{ peak}} - T_{mb} = 62 = \Delta T_{j-mb}$$

This is within the maximum allowable ΔT_{j-mb} of 115 °C

The graph on page 8 shows the maximum allowable peak power dissipations for various pulse durations as a function of collector-emitter voltage for a duty cycle of 0.01.

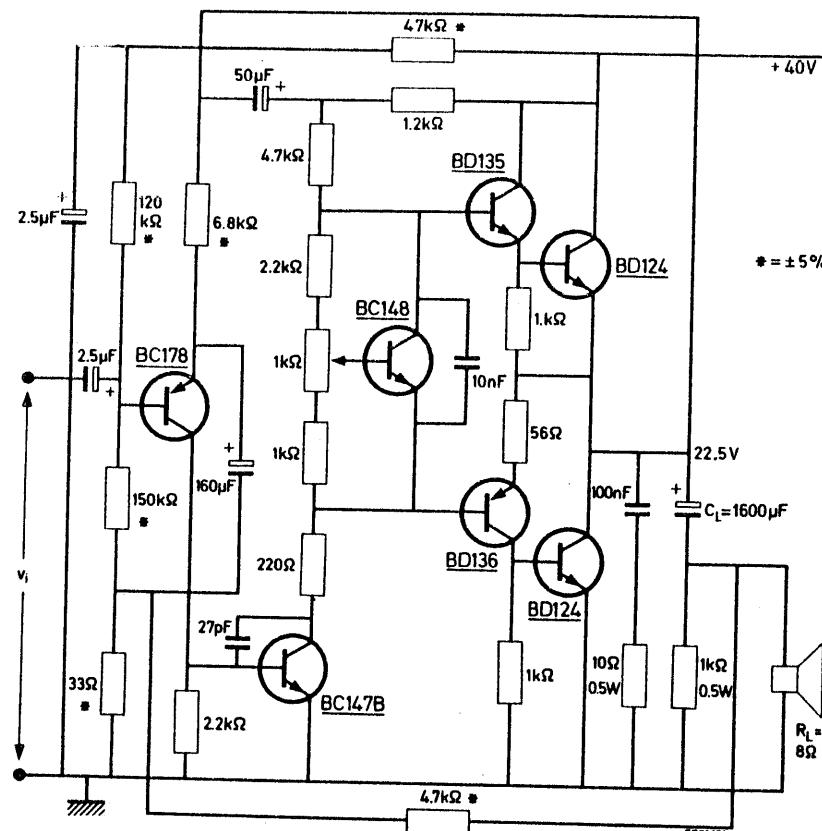
1) $R_{th t'} = R_{th t} \times M$ (for $R_{th t}$ see page 5)





APPLICATION INFORMATION

Matched pair 2-BD124 in a 15 W hi-fi audio amplifier.



Performance

Output power at $f = 1 \text{ kHz}$; $d_{\text{tot}} = 1 \%$

Input impedance

Input sensitivity ($P_o = 15 \text{ W}$)

Total harmonic distortion at onset of clipping ($f = 1 \text{ kHz}$)

Intermodulation distortion

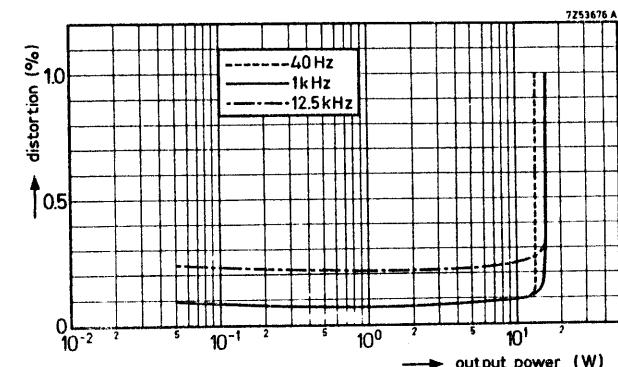
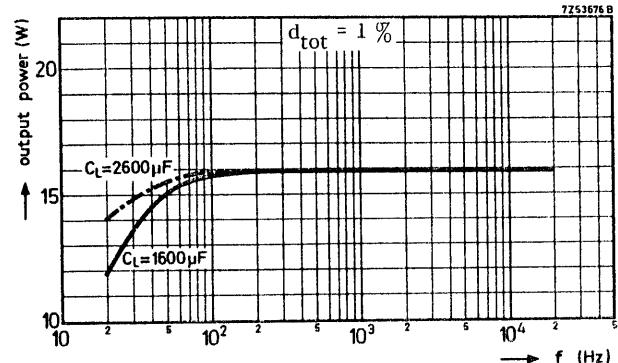
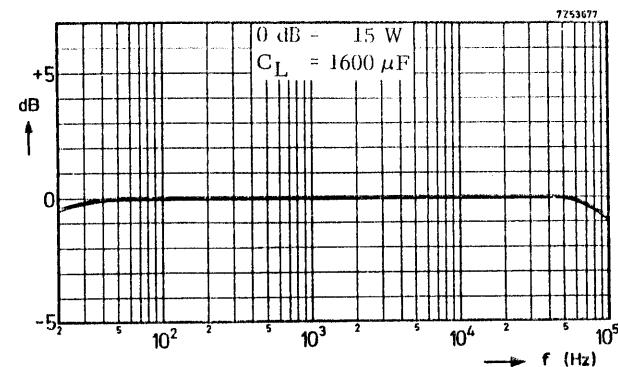
Frequency response (-1 dB)

Supply voltage

Collector quiescent current of BD124

15.8 W
100 kΩ
140 mV
0.15 %
0.6 %
20 Hz to 90 kHz
nom. 40 V
max. 45 V
40 mA

APPLICATION INFORMATION (continued)



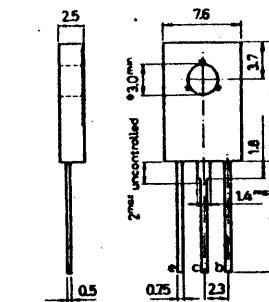
SILICON PLANAR EPITAXIAL TRANSISTORS

DEVELOPMENT SAMPLE DATA

N-P-N transistors in a plastic envelope primarily intended for use with the p-n-p BD136, BD138 and BD140 as complementary driver pairs in hi-fi amplifiers. Single transistors are recommended in driver stages where a high voltage and high dissipation are required.

MECHANICAL DATA

Mounting surface
connected to the
collector



Dimensions in mm

RATINGS (Limiting values according to the Absolute Maximum System as defined in IEC publication 134)

Voltages

	BD135	BD137	BD139
Collector-base voltage (open emitter)	V _{CBO} max. 45	60	80 V
Collector-emitter voltage (open base)	V _{CEO} max. 45	60	80 V
Emitter-base voltage (open collector)	V _{EBO} max. 15	5	5 V

Currents

	I _C max.	0.35	A
Collector current (d.c.)	I _{CM} max.	1.0	A
Collector current (peak value)	I _B max.	0.1	A

Power dissipation

Total power dissipation	P _{tot} max.	2.0	W

These data, based on the specifications and measured performance of development samples, afford a preliminary indication of the characteristics to be expected of the described product. Distribution of development samples implies no guarantee as to the subsequent availability of the product

RATINGS (continued)Temperatures

Storage temperature

T_{stg} -55 to +125 °C

Junction temperature

T_J max. 125 °C**THERMAL RESISTANCE**

From junction to ambient in free air

R_{th J-a} 100 °C/W

From junction to mounting base

R_{th J-nb} 10 °C/W**CHARACTERISTICS**T_{amb} = 25 °C unless otherwise specifiedCollector cut-off current-V_{CB} = 30 V-I_{CBO} < 100 nAD.C. current gain-I_C = 150 mA; -V_{CE} = 2 V

BD136	h _{FE}	40 to 160
BD138		

BD140	h _{FE}	63 to 250
BD136/01		

Base-emitter voltageI_E = 5 mA; -V_{CB} = 2 V-V_{BE} typ. 0.67 VI_E = 500 mA; -V_{CB} = 2 V-V_{BE} typ. 0.85 V

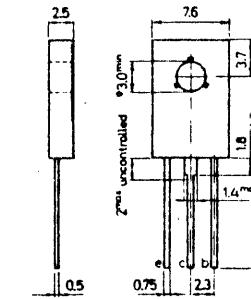
< 1.0 V

Collector capacitance at f = 1 MHzI_E = I_e = 0; -V_{CB} = 10 VC_c typ. 15 pFTransition frequency at f = 35 MHz-I_C = 50 mA; -V_{CE} = 5 Vf_T typ. 75 MHz**SILICON PLANAR EPITAXIAL TRANSISTORS****DEVELOPMENT SAMPLE DATA**

P-N-P transistors in a plastic envelope primarily intended for use with the n-p-n BD135, BD137 and BD139 as complementary driver pairs in hi-fi amplifiers. Single transistors are recommended in driver stages where a high voltage and high dissipation are required.

MECHANICAL DATA

Mounting surface connected to the collector



Dimensions in mm

RATINGS (Limiting values according to the Absolute Maximum System as defined in IEC publication 134)Voltages

	BD136	BD138	BD140
Collector-base voltage (open emitter)	-V _(BO) max. 45	60	80 V
Collector-emitter voltage (open base)	-V _(CEO) max. 45	60	80 V
Emitter-base voltage (open collector)	-V _(EBO) max. 5	5	5 V

Currents

	BD136	BD138	BD140
Collector current (d.c.)	-I _C max. 0.35	A	
Collector current (peak value)	-I _{CM} max. 1.0	A	
Base current (d.c.)	-I _B max. 0.1	A	

Power dissipation

Total power dissipation	P _{tot}	max.	2.0	W

These data, based on the specifications and measured performance of development samples, afford a preliminary indication of the characteristics to be expected of the described product. Distribution of development samples implies no guarantee as to the subsequent availability of the product

RATINGS (continued)

Temperatures

Storage temperature	T _{stg}	-55 to +125 °C
Junction temperature	T _j	max. 125 °C

THERMAL RESISTANCE

From junction to ambient in free air	R _{th j-a}	= 100 °C/W
From junction to mounting base	R _{th j-mb}	= 10 °C/W

CHARACTERISTICS

Collector cut-off current	I _{CBO}	100 nA
V _{CB} = 30 V		

D.C. current gain

I _C = 150 mA; V _{CE} = 2 V	BD135 BD137 BD139	h _{FE}	40 to 160
	BD135/01	h _{FE}	.63 to 250

Base emitter voltage

-I _E = 5 mA; V _{CB} = 2 V	V _{BE}	typ. 0.66 V
-I _E = 500 mA; V _{CB} = 2 V	V _{BE}	typ. 0.82 V < 1.0 V

Collector capacitance at f = 1 MHz

I _E = I _e = 0; V _{CB} = 10 V	C _c	typ. 10 pF
---	----------------	------------

Transition frequency at f = 35 MHz

I _C = 50 mA; V _{CE} = 5 V	f _T	typ. 250 MHz
---	----------------	--------------

HIGH VOLTAGE SILICON POWER TRANSISTOR

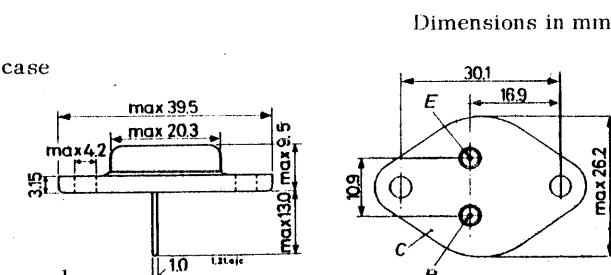
DEVELOPMENT SAMPLE DATA

N-P-N silicon high voltage transistor designed for use in horizontal deflection circuits in mains fed high performance television receivers.

MECHANICAL DATA

Collector connected to case

TO-3

RATINGS (Limiting values)¹⁾

Collector-base voltage (open emitter)	V _{CBO}	max. 1500 V
Emitter-base voltage (open collector)	V _{EBO}	max. 6 V
Collector current (d.c.)	I _C	max. 2 A
Base current (peak value)	I _{BM}	max. 2 A
Reverse base current (peak value) $\delta = 0.1$; $t_p = 5 \mu s$	-I _{BM}	max. 3 A
Total power dissipation	P _{tot}	max. 7 W
Storage temperature	T _{stg}	-55 to +115 °C
Junction temperature	T _j	max. 115 °C

THERMAL RESISTANCE

From junction to mounting base

$$R_{th j-mb} = 2.5 \text{ °C/W}$$

) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

These data, based on the specifications and measured performance of development samples, afford a preliminary indication of the characteristics to be expected of the described product. Distribution of development samples implies no guarantee as to the subsequent availability of the product

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

Saturation voltages

$I_C = 2 \text{ A}; I_B = 1 \text{ A}$

$V_{CEsat} < 5 \text{ V}$
 $V_{BEsat} < 1.5 \text{ V}$

Turn off time when switched from

$I_C = 2 \text{ A}; I_B = 0.75 \text{ A}$ to $-V_{BE} = 5 \text{ V}$

$t_{off} < 1.5 \mu\text{s}$

TRANSISTORI AL GERMANIO
PER ALTA FREQUENZA

SILICON PLANAR TRANSISTOR

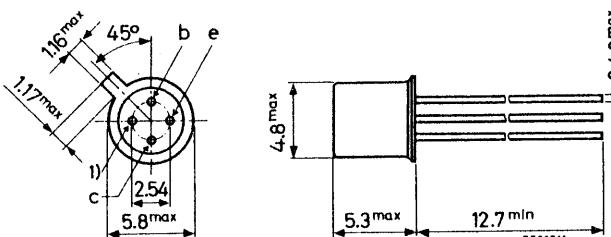
N-P-N transistor in a TO-72 metal envelope with a shield lead connected to the case; the same transistor is available in lock-fit encapsulation under the type-number BF196. It has a very low feedback capacitance and is intended for use in forward gain control stages in video intermediate frequency amplifiers of television receivers.

QUICK REFERENCE DATA		
Collector-base voltage (open emitter)	V_{CBO}	max. 40 V
Collector-emitter voltage (open base)	V_{CEO}	max. 30 V
Collector current (d.c.)	I_C	max. 25 mA
Total power dissipation up to $T_{amb} = 45^{\circ}\text{C}$	P_{tot}	max. 130 mW
Junction temperature	T_j	max. 175 $^{\circ}\text{C}$
Transition frequency $I_C = 4 \text{ mA}; V_{CE} = 10 \text{ V}$	f_T	typ. 350 MHz
Feedback capacitance at $f = 10.7 \text{ MHz}$ $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$	$-C_{re}$	typ. 0.15 pF
Max. unilateralised power gain $I_C = 4 \text{ mA}; V_{CE} = 10 \text{ V}; f = 35 \text{ MHz}$	G_{UM}	typ. 42 dB
Gain control range	ΔG_{tr}	typ. 60 dB

MECHANICAL DATA

Dimensions in mm

TO-72



1) = shield lead (connected to case)

Accessories available: 56246, 56263

RATINGS (Limiting values) ¹⁾VoltagesCollector-base voltage (open emitter) V_{CBO} max. 40 VCollector-emitter voltage (open base)
(See also page 5) V_{CEO} max. 30 VEmitter-base voltage (open collector) V_{EBO} max. 4 VCurrentsCollector current (d.c.) I_C max. 25 mACollector current (peak value) I_{CM} max. 25 mAPower dissipationTotal power dissipation up to $T_{amb} = 45^{\circ}\text{C}$ P_{tot} max. 130 mWTemperaturesStorage temperature T_{stg} -65 to +175 $^{\circ}\text{C}$ Junction temperature T_j max. 175 $^{\circ}\text{C}$ **THERMAL RESISTANCE**From junction to ambient in free air $R_{th\ j-a}$ 1.0 $^{\circ}\text{C}/\text{mW}$ **CHARACTERISTICS** $T_{amb} = 25^{\circ}\text{C}$ unless otherwise specifiedBase current $I_C = 4 \text{ mA}; V_{CE} = 10 \text{ V}$ I_B typ. 70 μA
< 150 μA Base-emitter voltage $I_C = 4 \text{ mA}; V_{CE} = 10 \text{ V}$ V_{BE} typ. 700 mV ¹⁾Feedback capacitance at $f = 10.7 \text{ MHz}$ $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ $-C_{re}$ typ. 150 fF ²⁾Transition frequency $I_C = 4 \text{ mA}; V_{CE} = 10 \text{ V}$ f_T typ. 350 MHzNoise figure at $f = 35 \text{ MHz}$ $I_C = 4 \text{ mA}; V_{CE} = 10 \text{ V}; G_S = 10 \text{ m}\Omega^{-1}; B_S = 0$ F typ. 3 dBy parameters at $f = 35 \text{ MHz}$ $I_C = 4 \text{ mA}; V_{CE} = 10 \text{ V}$ g_{ie} typ. 4.8 $\text{m}\Omega^{-1}$

Input conductance

 C_{ie} typ. 45 pF

Input capacitance

 $|y_{re}|$ typ. 37 $\mu\Omega^{-1}$

Feedback admittance

 φ_{re} typ. 268 $^{\circ}$

Phase angle of feedback admittance

 $|y_{fe}|$ typ. 95 $\text{m}\Omega^{-1}$

Transfer admittance

 φ_{fe} typ. 337 $^{\circ}$

Phase angle of transfer admittance

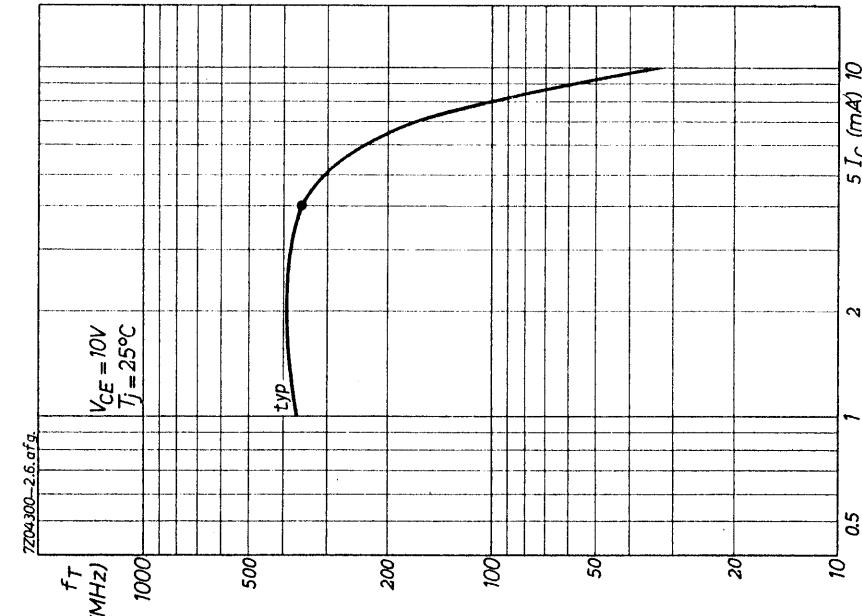
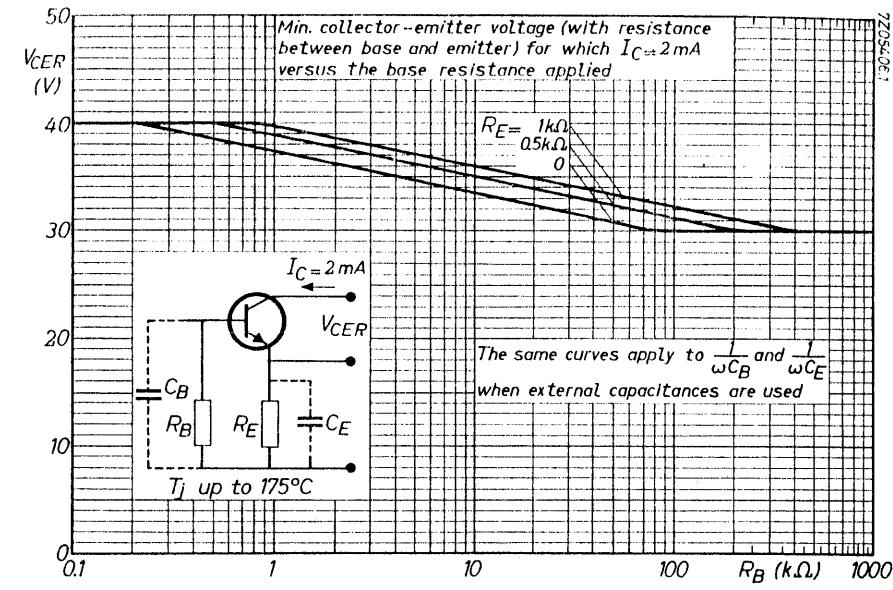
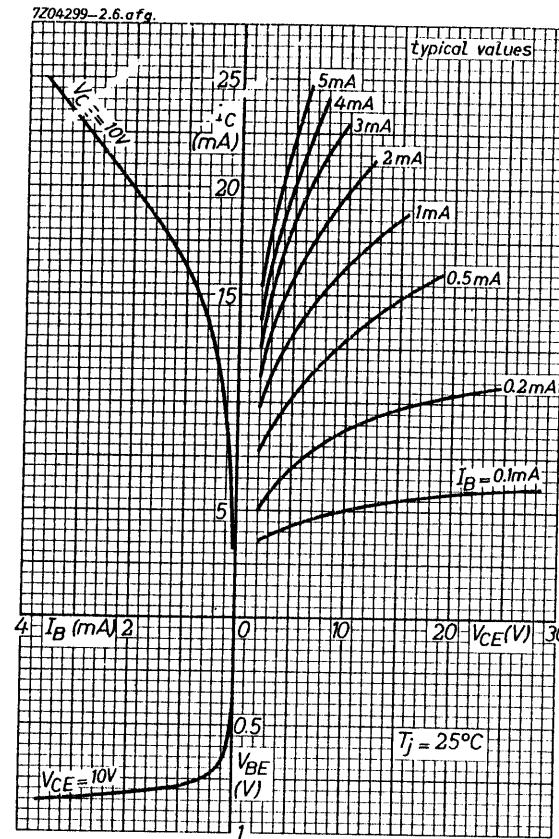
 g_{oe} typ. 30 $\mu\Omega^{-1}$

Output conductance

 C_{oe} typ. 1.2 pFMaximum unilateralised power gain

$$G_{UM} = \frac{|y_{fe}|^2}{4 g_{ie} g_{oe}}$$

 $I_C = 4 \text{ mA}; V_{CE} = 10 \text{ V}; f = 35 \text{ MHz}$ G_{UM} typ. 42 dB¹⁾ V_{BE} decreases with about 1.7 mV/ $^{\circ}\text{C}$ at increasing temperature²⁾ 1 fF = 1 femtofarad = 10^{-15} F ¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.



APPLICATION INFORMATION

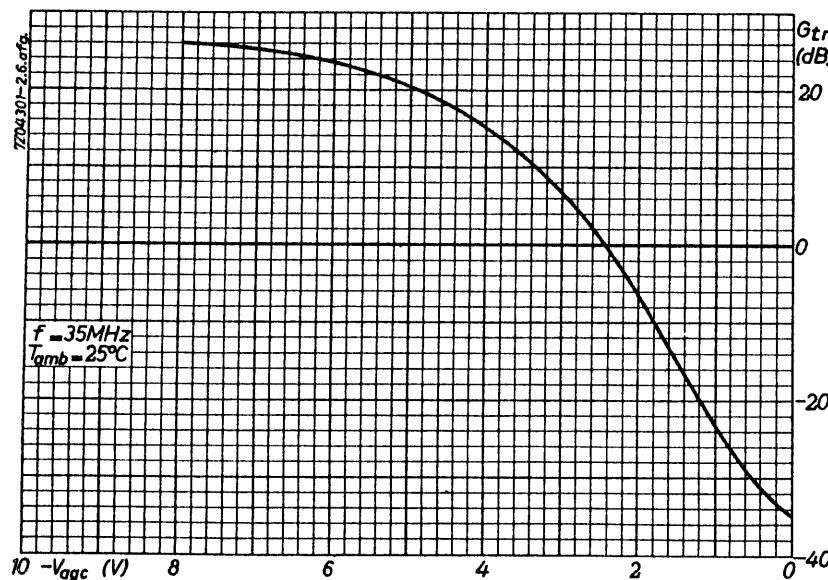
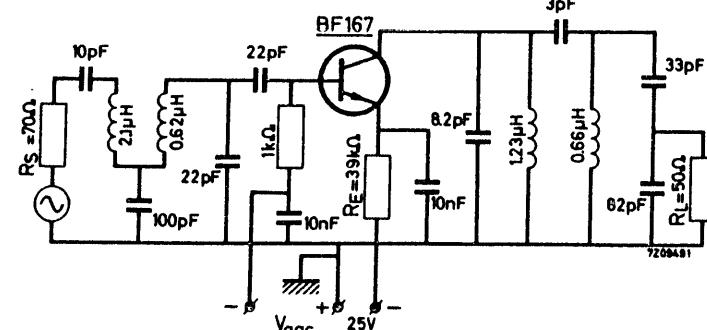
First stage of an intermediate frequency amplifier with a BF167 transistor.
(Basic circuit with voltage gain control).

Transducer gain

$$G_{tr} = \frac{\text{output power in load } R_L}{\text{available power from source with } R_S}$$

$I_C = 4 \text{ mA}; f = 35 \text{ MHz}$

Gain control range



SILICON PLANAR EPITAXIAL TRANSISTOR

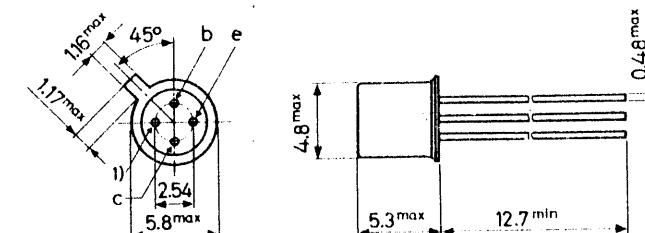
N-P-N transistor in a TO-72 metal envelope with a shield lead connected to the case; the same transistor is available in lock-fit encapsulation under the type-number BF197. It has a very low feedback capacitance and is intended for use in video intermediate frequency amplifiers, in particular for the output stages.

QUICK REFERENCE DATA	
Collector-base voltage (open emitter)	V_{CBO} max. 40 V
Collector-emitter voltage (open base)	V_{CEO} max. 25 V
Collector current (d.c.)	I_C max. 25 mA
Total power dissipation up to $T_{amb} = 45^\circ\text{C}$	P_{tot} max. 260 mW
Junction temperature	T_j max. 175 °C
Transition frequency $I_C = 5 \text{ mA}; V_{CE} = 10 \text{ V}$	f_T typ. 550 MHz
Feedback capacitance at $f = 10.7 \text{ MHz}$ $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$	$-C_{re}$ typ. 0.23 pF
Max. unilateralised power gain $I_C = 7 \text{ mA}; V_{CE} = 10 \text{ V}; f = 35 \text{ MHz}$	G_{UM} typ. 42.5 dB
Output voltage in the circuit of page 4	V_O typ. 7.7 V

MECHANICAL DATA

Dimensions in mm

TO-72



1) = shield lead (connected to case)

Accessories available: 56246, 56263

RATINGS (Limiting values) ¹⁾VoltagesCollector-base voltage (open emitter) V_{CBO} max. 40 VCollector-emitter voltage (open base)
(See also page A) V_{CEO} max. 25 VEmitter-base voltage (open collector) V_{EBO} max. 4 VCurrentsCollector current (d.c.) I_C max. 25 mACollector current (peak value) I_{CM} max. 25 mAPower dissipationTotal power dissipation up to $T_{amb} = 45^{\circ}\text{C}$
with cooling fin No. 56263 ²⁾ P_{tot} max. 260 mWTemperaturesStorage temperature T_{stg} -65 to $+175^{\circ}\text{C}$ Junction temperature T_j max. 175°C **THERMAL RESISTANCE**From junction to ambient in free air R_{thj-a} = $0.65^{\circ}\text{C}/\text{mW}$ From junction to ambient with cooling
fin No. 56263 R_{thj-a} = $0.5^{\circ}\text{C}/\text{mW}$ **CHARACTERISTICS** $T_{amb} = 25^{\circ}\text{C}$ unless otherwise specifiedBase current $I_C = 7 \text{ mA}; V_{CE} = 10 \text{ V}$ I_B typ. 80 μA
 $< 185 \mu\text{A}$ Base-emitter voltage $I_C = 7 \text{ mA}; V_{CE} = 10 \text{ V}$ V_{BE} typ. 740 mV ¹⁾
 $< 900 \text{ mV}$ Feedback capacitance at $f = 10.7 \text{ MHz}$ $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ $-C_{re}$ typ. 230 fF ²⁾Transition frequency $I_C = 5 \text{ mA}; V_{CE} = 10 \text{ V}$ f_T typ. 550 MHzy parameters at $f = 35 \text{ MHz}$ $I_C = 7 \text{ mA}; V_{CE} = 10 \text{ V}$ g_{ie} typ. $4.5 \text{ m}\Omega^{-1}$

Input conductance

 C_{ie} typ. 45 pF

Input capacitance

 $|y_{re}|$ typ. $55 \mu\Omega^{-1}$

Feedback admittance

 φ_{re} typ. 266°

Phase angle of feedback admittance

 $|y_{fe}|$ typ. $145 \text{ m}\Omega^{-1}$

Transfer admittance

 φ_{fe} typ. 338°

Phase angle of transfer admittance

 g_{oe} typ. $65 \mu\Omega^{-1}$

Output conductance

 C_{oe} typ. 2.1 pF

Output capacitance

Maximum unilateralised power gain

$$G_{UM} = \frac{|y_{fel}|^2}{4 g_{ie} g_{oe}}$$

 $I_C = 7 \text{ mA}; V_{CE} = 10 \text{ V}; f = 35 \text{ MHz}$ G_{UM} typ. 42.5 dB¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.²⁾ Peak power dissipation see page 5.¹⁾ V_{BE} decreases with about $1.7 \text{ mV}/^{\circ}\text{C}$ at increasing temperature²⁾ 1 fF = 1 femtofarad = 10^{-15} F

APPLICATION INFORMATION

Output stage of an intermediate frequency amplifier with a BF173 transistor.

Output voltage of the i.f. output stage

Voltage across the detector load $R_L = 2.7 \text{ k}\Omega$
for 30% synchronisation pulse compression

$f = 38.9 \text{ MHz}$; $I_C = 7.2 \text{ mA}$; $V_{CE} = 16.6 \text{ V}$

$V_O > 6 \text{ V}$
typ. 7.7 V

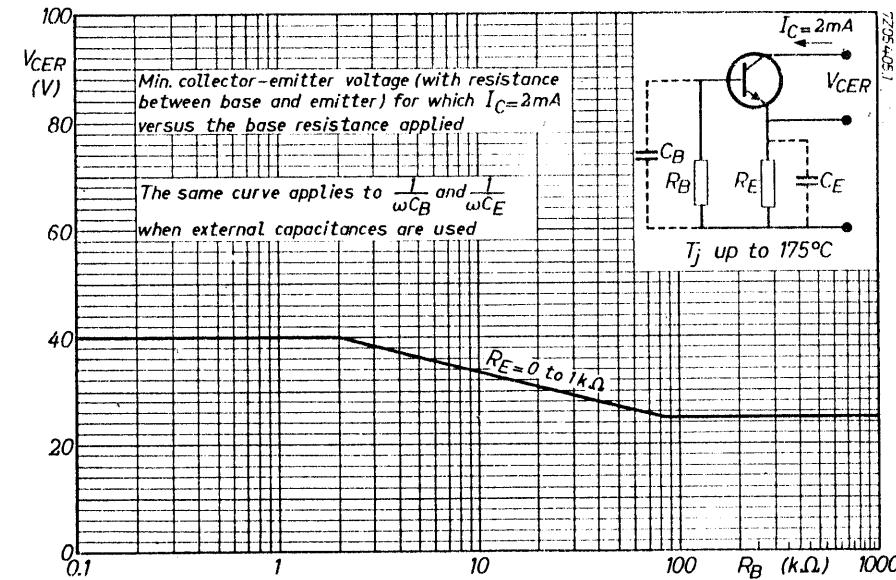
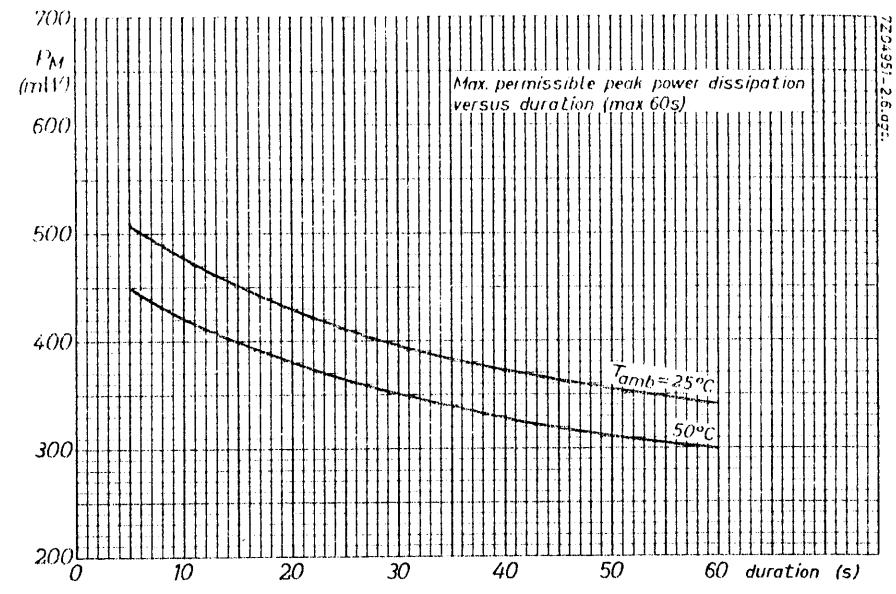
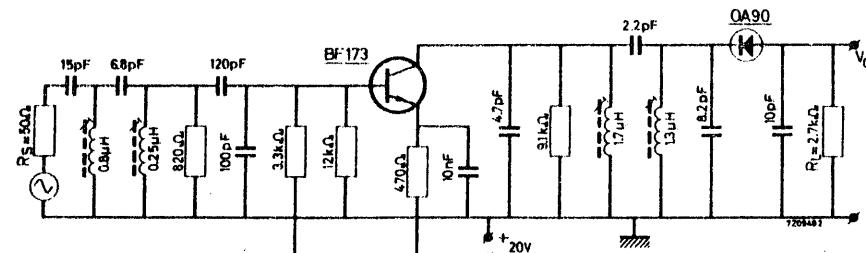
Transducer gain

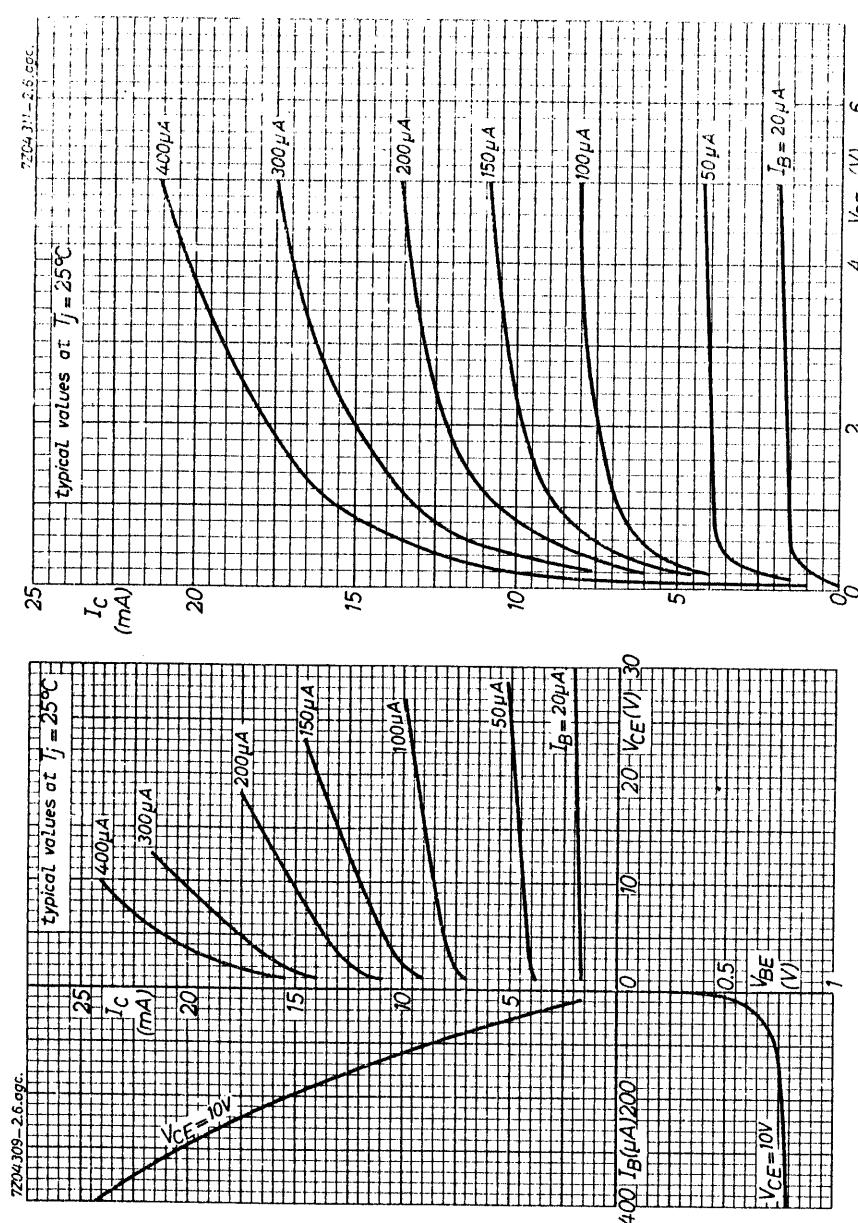
$G_{TR} = \frac{\text{output power in load } R_L}{\text{available power from source with } R_S}$

$f = 36.4 \text{ MHz}$; $I_C = 7.2 \text{ mA}$; $V_{CE} = 16.6 \text{ V}$

G_{TR} typ. 26 dB

Tuning frequency for all tuned circuits is 37 MHz





N-P-N SILICON PLANAR TRANSISTORS FOR VIDEO OUTPUT STAGES

N-P-N transistors in a TO-5 metal envelope with the collector connected to the case.

The BF177 is intended for tiny-vision black and white television receivers.
The BF178 and BF179 for application in large screen black and white television receivers.

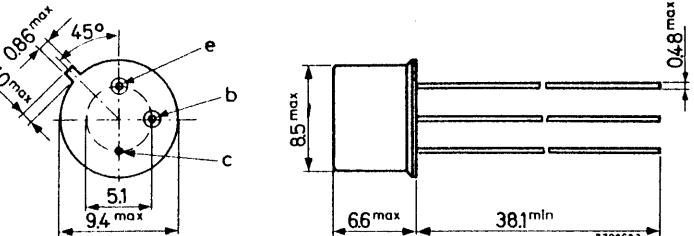
QUICK REFERENCE DATA

	BF177	BF178	BF179	
Collector-base voltage (open emitter)	V_{CBO}	max. 100	160	250 V
Collector-emitter voltage (open base)	V_{CEO}	max. 60	115	115 V
Collector current (peak value)	I_{CM}	max. 50	50	50 mA
Total power dissipation up to $T_{amb} = 65^\circ\text{C}$	P_{tot}	max. 0.6	0.6	0.6 W
up to $T_{mb} = 130^\circ\text{C}$	P_{tot}	max.	1.7	1.7 W
Junction temperature	T_j	max. 200	200	200 $^\circ\text{C}$
D.C. current gain at $T_j = 25^\circ\text{C}$				
$I_C = 15 \text{ mA}; V_{CE} = 10 \text{ V}$	h_{FE}	>	20	
$I_C = 20 \text{ mA}; V_{CE} = 15 \text{ V}$	h_{FE}	>	20	
$I_C = 30 \text{ mA}; V_{CE} = 20 \text{ V}$	h_{FE}	>	20	
Transition frequency	f_T	typ. 120	120	120 MHz
Feedback capacitance	$-C_{re}$	typ. 1.8	1.8	1.8 pF

MECHANICAL DATA

TO-5

Collector connected to case



Accessories available: 56218; 56245; 56265
MOUNTING METHOD see page 4

RATINGS (Limiting values) 1)

Voltages

	BF177	BF178	BF179
Collector-base voltage (open emitter) V_{CBO}	max. 100	160	250 V ²⁾
Collector-emitter voltage ($R_B \leq 1 \text{ k}\Omega$) V_{CE}	max. 100	160	250 V ²⁾
Collector-emitter voltage (open base) $I_C = 4 \text{ mA}$			

	BF177	BF178	BF179
Emitter-base voltage (open collector) V_{CEO}	max. 60	115	115 V
Emitter-base voltage (open collector) V_{EBO}	max. 5	5	5 V

Currents

	BF177	BF178	BF179
Collector current (d.c.) I_C	max. 50	50	50 mA
Collector current (peak value) I_{CM}	max. 50	50	50 mA

Power dissipation

	BF177	BF178	BF179
Total power dissipation up to $T_{amb} = 65^\circ\text{C}$ in free air	max. 0.6	0.6	0.6 W
up to $T_{amb} = 130^\circ\text{C}$	max. 1.7	1.7	1.7 W

Temperatures

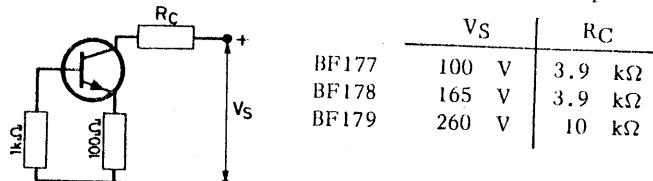
	BF177	BF178	BF179
Storage temperature T_{stg}	-55 to +175 $^\circ\text{C}$		
Junction temperature T_j	max. 200 $^\circ\text{C}$		

THERMAL RESISTANCE (see page 4)

	BF177	BF178	BF179
From junction to ambient in free air $R_{th j-a}$	= 220	220	220 $^\circ\text{C}/\text{W}$
From junction to mounting base $R_{th j-mb}$	= 40	40	40 $^\circ\text{C}/\text{W}$

CHARACTERISTICS

	BF177	BF178	BF179
Collector cut-off current at $T_j = 200^\circ\text{C}$ I_{CER}	typ. 0.03	0.05	0.10 mA
	< 4	4	4 mA



at V_{CEmax} ; $T_j = 25^\circ\text{C}$ $I_{CER} < 1 \text{ mA}$

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

→ 2) During switching on, a supply voltage of 1.2 times the rated V_{CE} value is permitted.

The current must be limited so that maximum dissipation and maximum junction temperature are not exceeded (see page 8).

CHARACTERISTICS (continued)

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

Base current

$I_C = 15 \text{ mA}; V_{CE} = 10 \text{ V}$	BF177	I_B	typ. 0.36 mA
$I_C = 20 \text{ mA}; V_{CE} = 15 \text{ V}$	BF179	I_B	typ. 0.45 mA

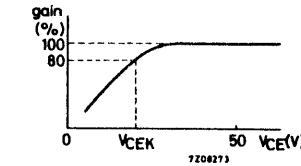
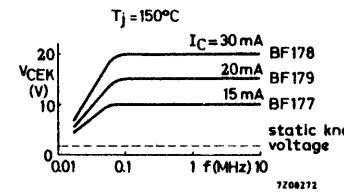
$I_C = 30 \text{ mA}; V_{CE} = 20 \text{ V}$	BF178	I_B	typ. 0.72 mA
$I_C = 15 \text{ mA}; V_{CE} = 10 \text{ V}$ for BF177			
$I_C = 20 \text{ mA}; V_{CE} = 15 \text{ V}$ for BF179			
$I_C = 30 \text{ mA}; V_{CE} = 20 \text{ V}$ for BF178			

V_{BE}	typ. 0.75 V
	< 1.2 V

High frequency knee voltage at $T_j = 150^\circ\text{C}$

BF177: $I_C = 15 \text{ mA}$	V_{CEK}	typ. 10 V
BF179: $I_C = 20 \text{ mA}$	V_{CEK}	typ. 15 V
BF178: $I_C = 30 \text{ mA}$	V_{CEK}	typ. 20 V

The high frequency knee voltage of a transistor is that value of the collector-emitter voltage at which the small signal gain, measured in a practical circuit, has dropped to 80% of the gain at $V_{CE} = 50 \text{ V}$. A further decrease of the collector-emitter voltage results in a rapid increase of the distortion of the signal.

Feedback capacitance at $f = 0.5 \text{ MHz}$

$I_C = 10 \text{ mA}; V_{CE} = 20 \text{ V}$	C_{Re}	typ. 1.8 pF
		< 3.5 pF

Feedback time constant at $f = 10 \text{ MHz}$

$-I_E = 10 \text{ mA}; V_{CB} = 10 \text{ V}$	$r_{bb'} \cdot C_{b'b'}$	typ. 25 ps
		< 100 ps

Transition frequency

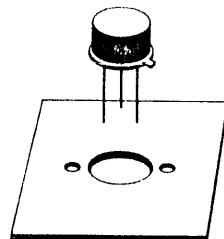
$I_C = 10 \text{ mA}; V_{CE} = 10 \text{ V}$	f_T	typ. 120 MHz

1) V_{BE} decreases by about 1.6 mV/ $^\circ\text{C}$ with increasing temperature.

MOUNTING METHOD

Transistor mounted directly on a heatsink ($R_{th\ j-mb} = 40\text{ }^{\circ}\text{C/W}$)
 $R_{th\ mb-h} \approx 3\text{ }^{\circ}\text{C/W}$

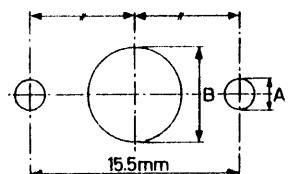
clamping washer of insulating material from accessory 56210



Fasten with M2.6 bolts

COMPONENTS of circuit on page 5

	BF177	BF178	BF179	V.
V_S	85	145	170	
R_1	390	560	820	$k\Omega$
R_2	1.2	2.2	1.8	$k\Omega$
R_3	1	1	1.5	$k\Omega$
R_4	470	680	560	Ω
R_5	300	300	300	Ω
R_6	47	56	56	Ω
R_7	120	100	120	Ω
R_8	4.7	3.9	5.6	$k\Omega$
R_9	180	150	120	Ω
R_{10}	820	560	470	Ω
C_1	180	220	330	pF
L	120	120	250	μH



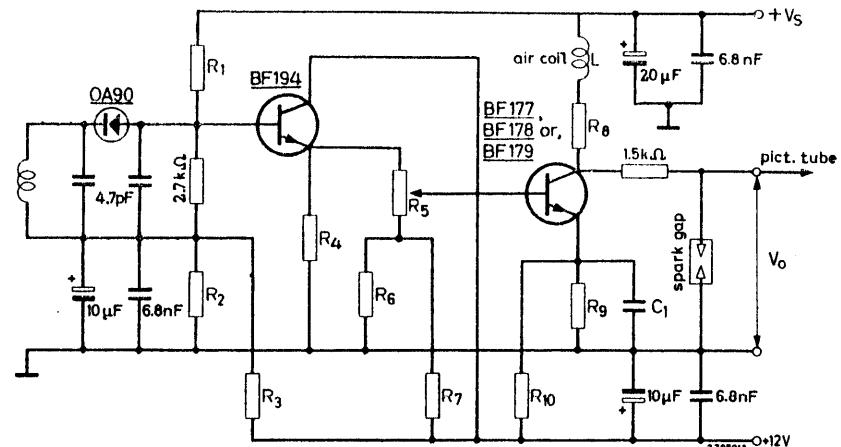
Diameter A: 2.8 mm

Diameter B: min. 7.0 mm
max. 7.7 mm

Recommended bore plan

APPLICATION INFORMATION

BF177 in the video output stage of a tiny-vision black and white television receiver.
BF178 or BF179 in the video output stage of large screen black and white television receivers.



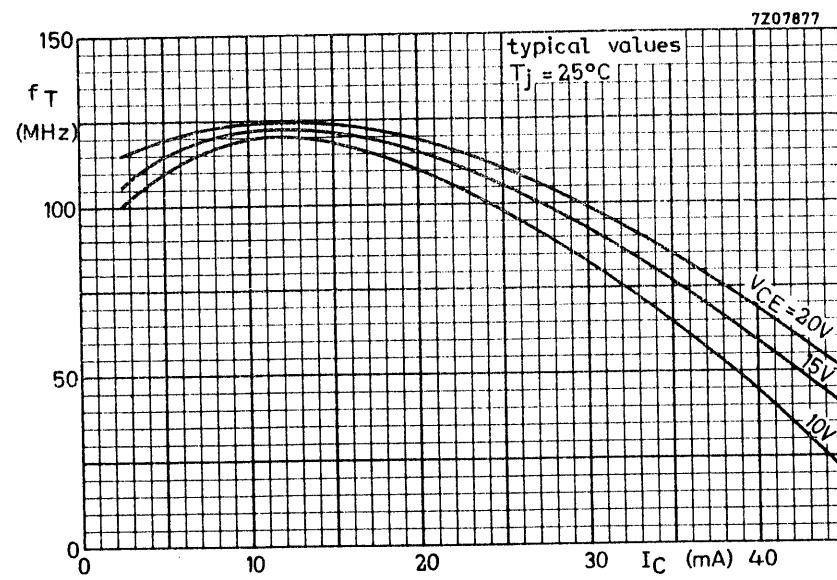
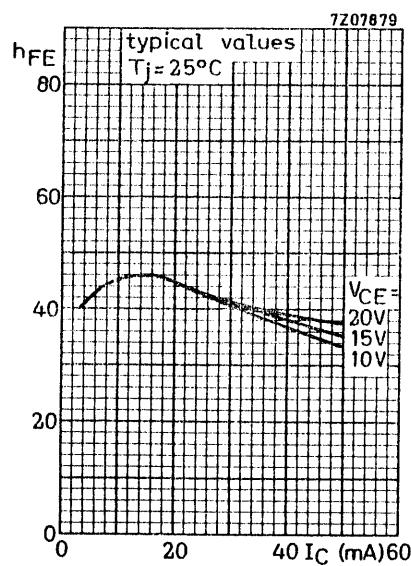
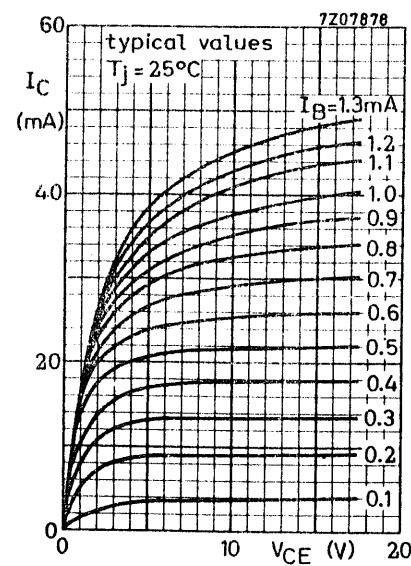
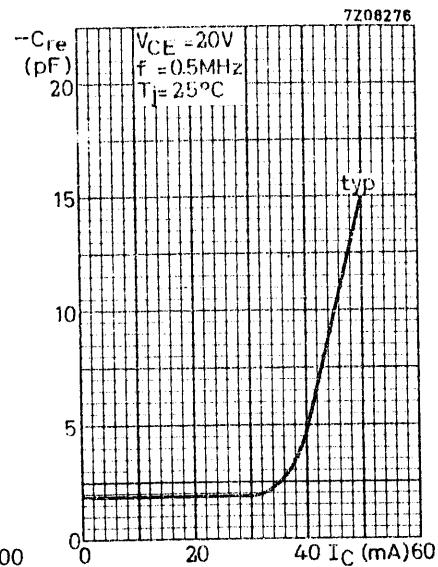
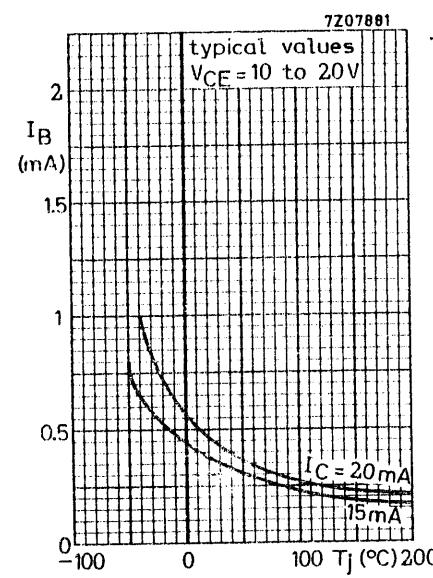
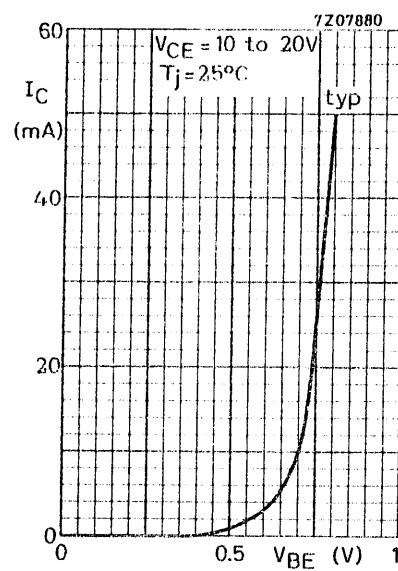
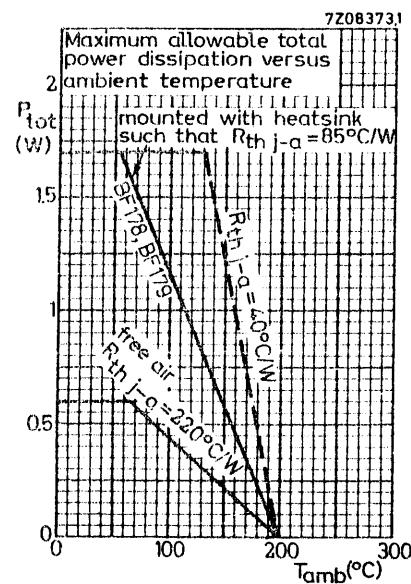
Performance

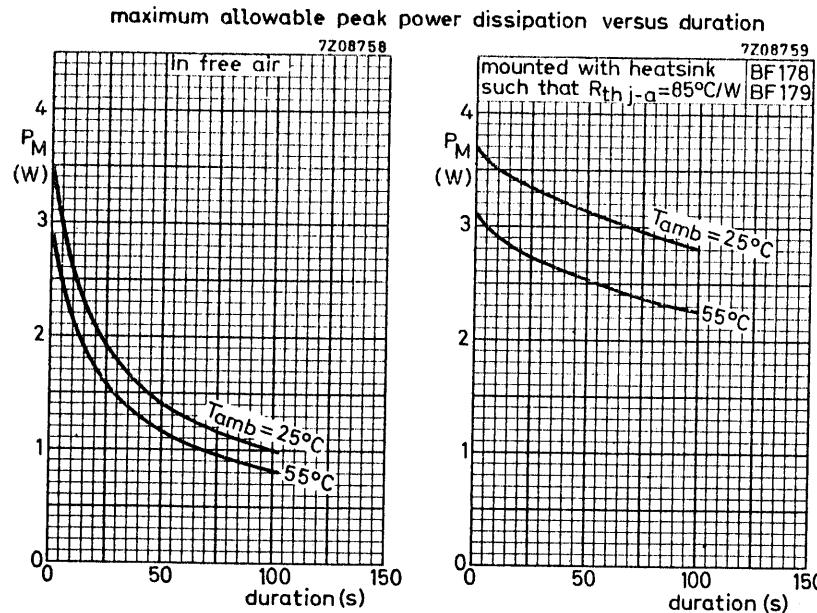
		BF177	BF178	BF179
Voltage gain	G_V	typ. 30	30	50
Output voltage (black-white)	V_o	typ. 50	80	110 V
Output voltage (peak-peak)	V_{om}	typ. 75	110	140 V
Bandwidth (3 dB)	B	> 4	4	3 MHz
Rise time	t_r	< 80	80	120 ns
Overshoot		< 5	5	3 %
Contrast control ratio		1:8	1:8	1:8

NOTES

- For the BF177 up to $T_{amb} = 55\text{ }^{\circ}\text{C}$ no heatsink is needed.
- In order to keep T_j below the maximum value for the BF178 and BF179 and to allow the maximum dissipation of 1.7 W the thermal resistance from junction to ambient should be: $R_{th\ j-a} \leq 85\text{ }^{\circ}\text{C/W}$.
- To ensure the above mentioned performance for bandwidth and transient response, the contribution to the total output capacitance of the device by the heatsink should not exceed 4 pF.

APPLICATION INFORMATION bulletins available on request



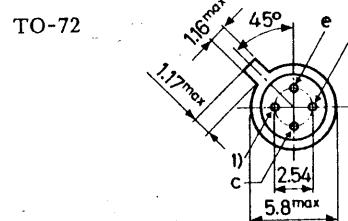


SILICON PLANAR TRANSISTOR

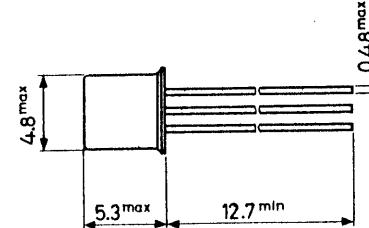
N-P-N transistor in a TO-72 metal envelope with insulated electrodes and a shield lead connected to the case. The BF180 is primarily intended for application in a forward gain controlled pre-amplifier in u.h.f. and integrated television tuners.

QUICK REFERENCE DATA			
Collector-base voltage (open emitter)	V _{CBO}	max.	30 V
Collector-emitter voltage (open base)	V _{CEO}	max.	20 V
Collector current (d.c.)	I _C	max.	20 mA
Total power dissipation up to T _{amb} = 25 °C	P _{tot}	max.	150 mW
Junction temperature	T _j	max.	175 °C
Transition frequency	f _T	typ.	675 MHz
I _C = 2 mA; V _{CE} = 10 V			
Feedback capacitance at f = 10.7 MHz	-C _{re}	typ.	280 fF
I _C = 1 mA; V _{CE} = 10 V			
Max. unilateralised power gain	G _{UM}	typ.	24 dB
-I _E = 2 mA; V _{CB} = 10 V; f = 200 MHz			
-I _E = 2 mA; V _{CB} = 10 V; f = 900 MHz	G _{UM}	typ.	12 dB
Noise figure at optimum source admittance			
-I _E = 2 mA; V _{CB} = 10 V; f = 200 MHz	F	typ.	2.5 dB
-I _E = 2 mA; V _{CB} = 10 V; f = 800 MHz	F	typ.	5.7 dB

MECHANICAL DATA



Dimensions in mm



1) = shield lead (connected to case)

Accessories available: 56246, 56263.

RATINGS (Limiting values) ¹⁾Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	3	V

Currents

Collector current (d.c.)	I_C	max.	20	mA
Collector current (peak value)	I_{CM}	max.	20	mA

Power dissipation

Total power dissipation up to $T_{amb} = 25^\circ\text{C}$	P_{tot}	max.	150	mW
--	-----------	------	-----	----

Temperatures

Storage temperature	T_{stg}	-65 to +175	$^\circ\text{C}$
Junction temperature	T_j	max.	175 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th j-a}$	=	1	$^\circ\text{C}/\text{mW}$
--------------------------------------	--------------	---	---	----------------------------

CHARACTERISTICS $T_{amb} = 25^\circ\text{C}$ unless otherwise specifiedBase current

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}$	I_B	typ.	45	μA
$-I_E = 12 \text{ mA}; V_{CB} = 7 \text{ V}$	I_B	<	150	μA

$-I_E = 12 \text{ mA}; V_{CB} = 7 \text{ V}$	I_B	<	2.2	mA
--	-------	---	-----	----

Emitter-base voltage

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}$	$-V_{EB}$	typ.	0.75	V
--	-----------	------	------	---

Feedback capacitance at $f = 10.7 \text{ MHz}$

$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$	$-C_{re}$	typ.	280	$\text{fF}^1)$
---	-----------	------	-----	----------------

Transition frequency

$I_C = 2 \text{ mA}; V_{CE} = 10 \text{ V}$	f_T	typ.	675	MHz
---	-------	------	-----	-----

Noise figure 2)

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; G_S = 40 \text{ m}\Omega^{-1}; B_S = 0; f = 200 \text{ MHz}$	F	typ.	4.5	dB
---	---	------	-----	----

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; G_S = 10 \text{ m}\Omega^{-1}; B_S = 0; f = 800 \text{ MHz}$	F	typ.	7.0	dB
---	---	------	-----	----

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; G_S = 10 \text{ m}\Omega^{-1}; B_S = 0; f = 800 \text{ MHz}$	F	typ.	9.5	dB
---	---	------	-----	----

Maximum unilaterised power gain ²⁾

$$G_{UM} = \frac{|y_{fb}|^2}{4 g_{ib} g_{ob}}$$

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 50 \text{ MHz}$	G_{UM}	>	32	dB
--	----------	---	----	----

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 200 \text{ MHz}$	G_{UM}	typ.	24	dB
---	----------	------	----	----

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 500 \text{ MHz}$	G_{UM}	typ.	14	dB
---	----------	------	----	----

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 900 \text{ MHz}$	G_{UM}	typ.	12	dB
---	----------	------	----	----

Transducer gain ²⁾

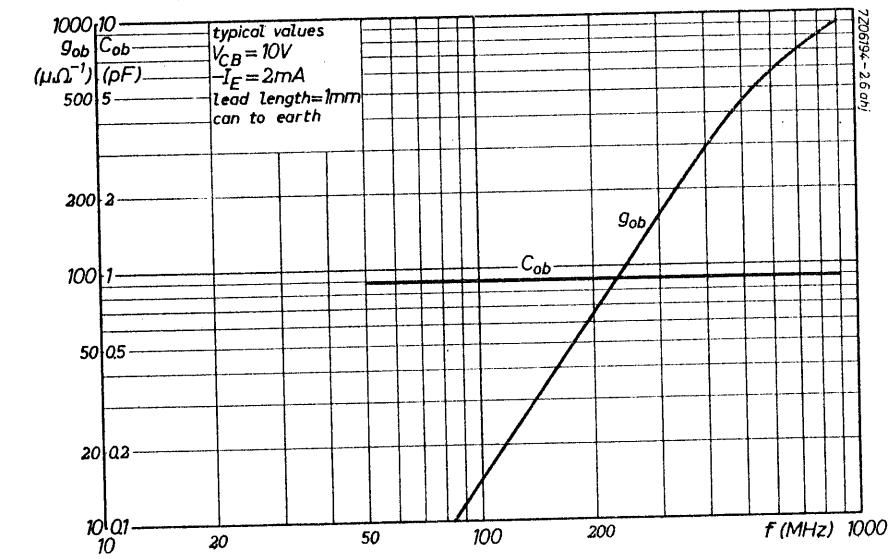
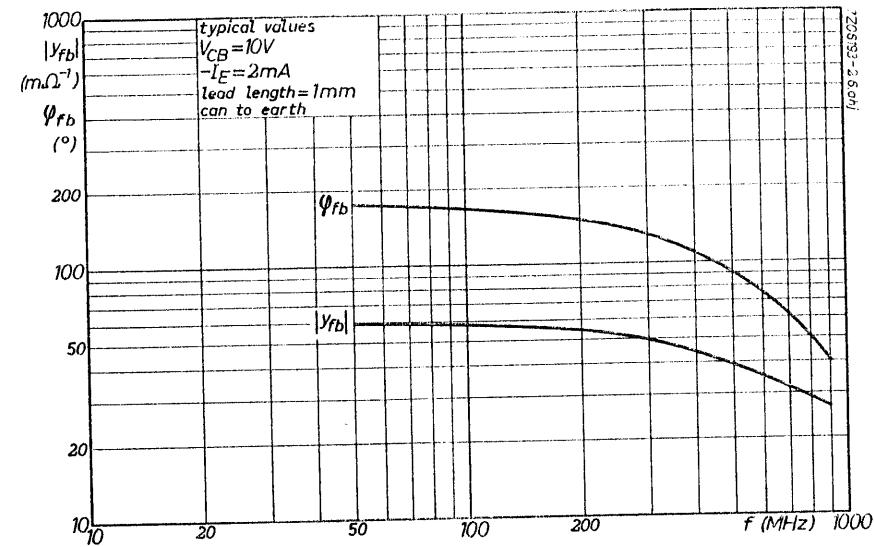
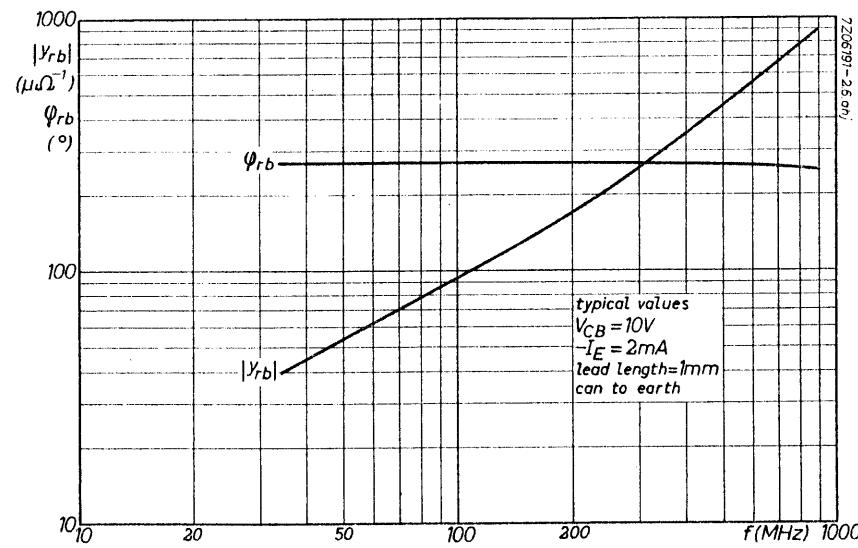
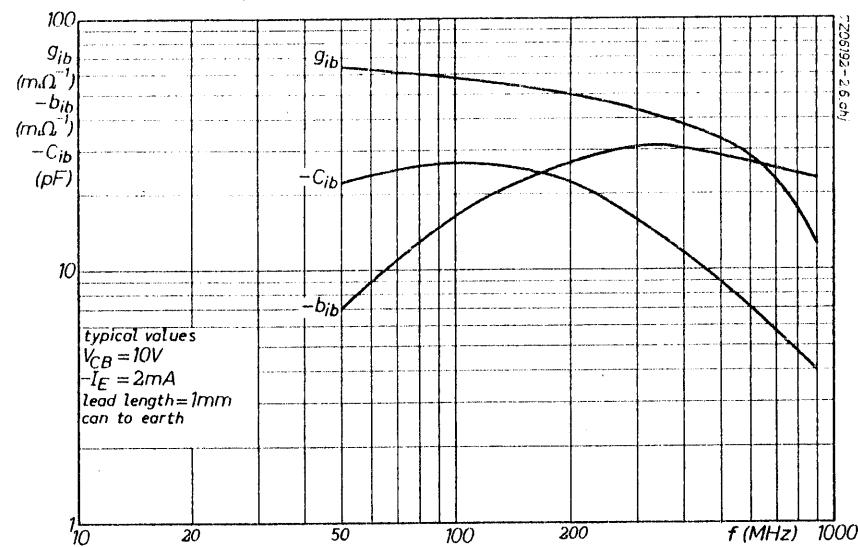
$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 200 \text{ MHz}; G_S = 40 \text{ m}\Omega^{-1}; B_S = 0$	G_{tr}	typ.	16.5	dB
---	----------	------	------	----

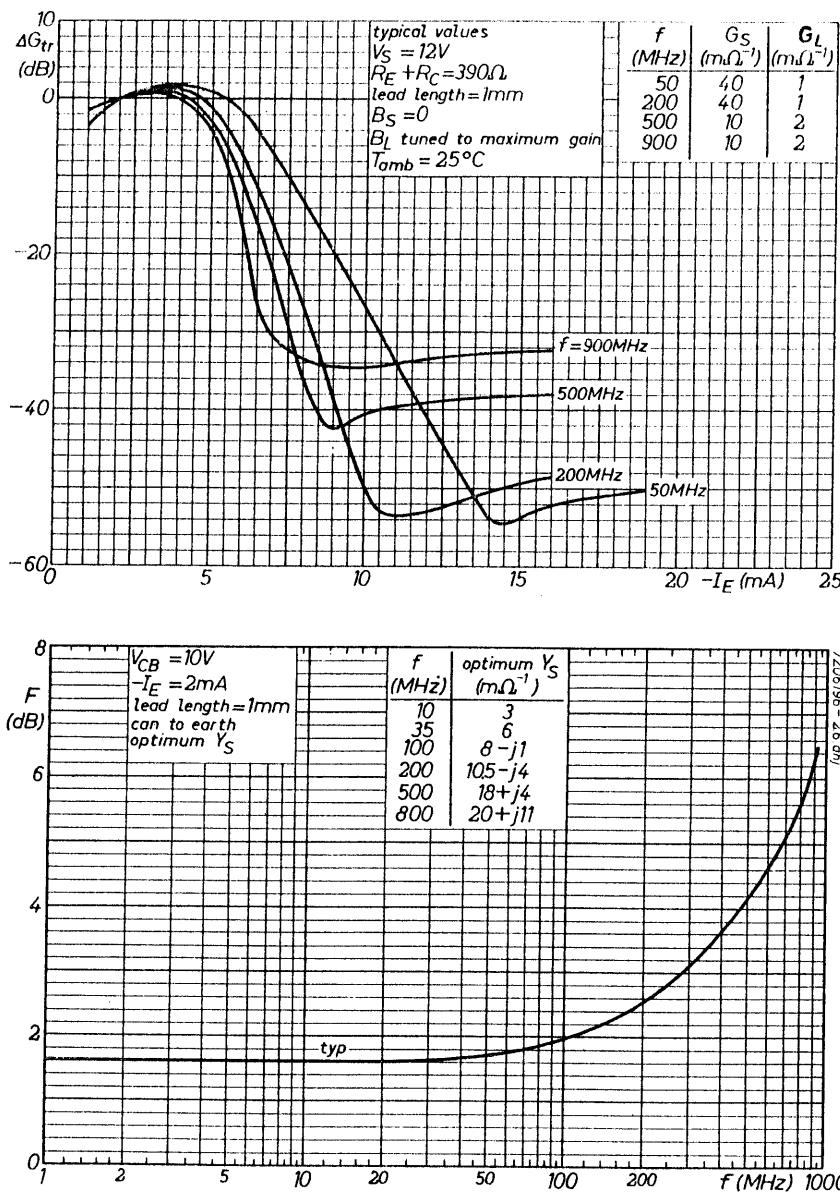
$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 900 \text{ MHz}; G_S = 20 \text{ m}\Omega^{-1}; B_S = 0$	G_{tr}	>	7.5	dB
---	----------	---	-----	----

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 900 \text{ MHz}; G_S = 2 \text{ m}\Omega^{-1}; B_S : \text{tuned}$	G_{tr}	typ.	9	dB
---	----------	------	---	----

¹⁾ 1 fF = 1 femtofarad = 10^{-15} F ²⁾ Common base configuration, metal envelope contacted to earth directly, external lead length: 1 mm.

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.





SILICON PLANAR TRANSISTOR

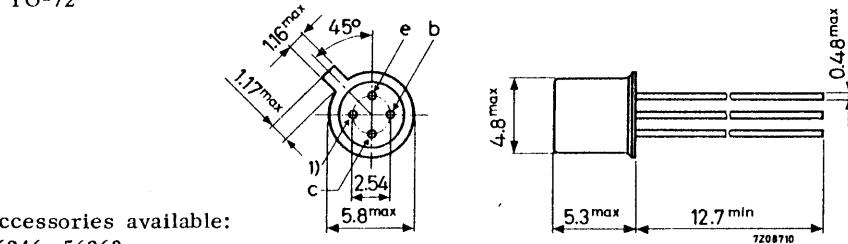
N-P-N transistor in a TO-72 metal envelope with insulated electrodes and a shield lead connected to the case. The BF181 is primarily intended for application as self-oscillating mixer in the u.h.f. band.

QUICK REFERENCE DATA		
Collector-base voltage (open emitter)	V_{CBO}	max. 30 V
Collector-emitter voltage (open base)	V_{CEO}	max. 20 V
Collector current (d.c.)	I_C	max. 20 mA
Total power dissipation up to $T_{amb} = 25^\circ C$	P_{tot}	max. 150 mW
Junction temperature	T_j	max. 175 $^\circ C$
Transition frequency		
$I_C = 2$ mA; $V_{CE} = 10$ V	f_T	typ. 600 MHz
Feedback capacitance at $f = 10.7$ MHz		
$I_C = 1$ mA; $V_{CE} = 10$ V	$-C_{re}$	typ. 280 fF
Max. unilateralised power gain		
$-I_E = 2$ mA; $V_{CB} = 10$ V; $f = 900$ MHz	G_{UM}	typ. 11 dB
Noise figure at optimum source admittance		
$-I_E = 2$ mA; $V_{CB} = 10$ V; $f = 900$ MHz	F	typ. 6.8 dB

MECHANICAL DATA

TO-72

Dimensions in mm



RATINGS (Limiting values)¹⁾Voltages

Collector-base voltage (open emitter)

V_{CBO} max. 30 V

Collector-emitter voltage (open base)

V_{CEO} max. 20 V

Emitter-base voltage (open collector)

V_{EBO} max. 3 VCurrents

Collector current (d.c.)

I_C max. 20 mA

Collector current (peak value)

I_{CM} max. 20 mAPower dissipationTotal power dissipation up to T_{amb} = 25 °CP_{tot} max. 150 mWTemperatures

Storage temperature

T_{stg} -65 to +175 °C

Junction temperature

T_j max. 175 °C**THERMAL RESISTANCE**

From junction to ambient in free air

R_{th j-a} = 1 °C/mW**CHARACTERISTICS**T_{amb} = 25 °C unless otherwise specifiedBase current-I_E = 2 mA; V_{CB} = 10 VI_B typ. < 150 μAEmitter-base voltage-I_E = 2 mA; V_{CB} = 10 V-V_{EB} typ. 0.75 VFeedback capacitance at f = 10.7 MHzI_C = 1 mA; V_{CE} = 10 V-C_{re} typ. 280 fF¹⁾Transition frequencyI_C = 2 mA; V_{CE} = 10 Vf_T typ. 600 MHzy parameters at f = 35 MHz²⁾-I_E = 2 mA; V_{CB} = 10 Vg_{ob} < 10 μΩ⁻¹

Output conductance

C_{ob} typ. 0.9 pF

Output capacitance

Maximum unilateralised power gain²⁾

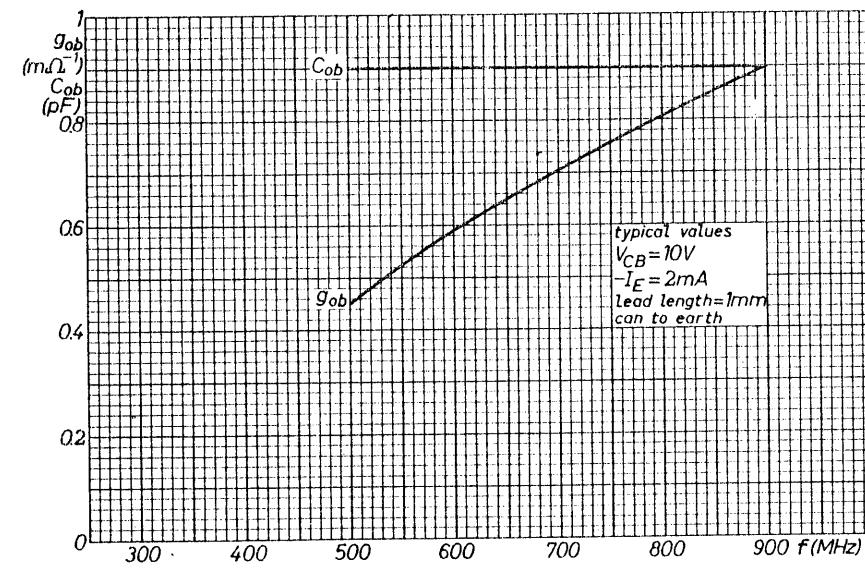
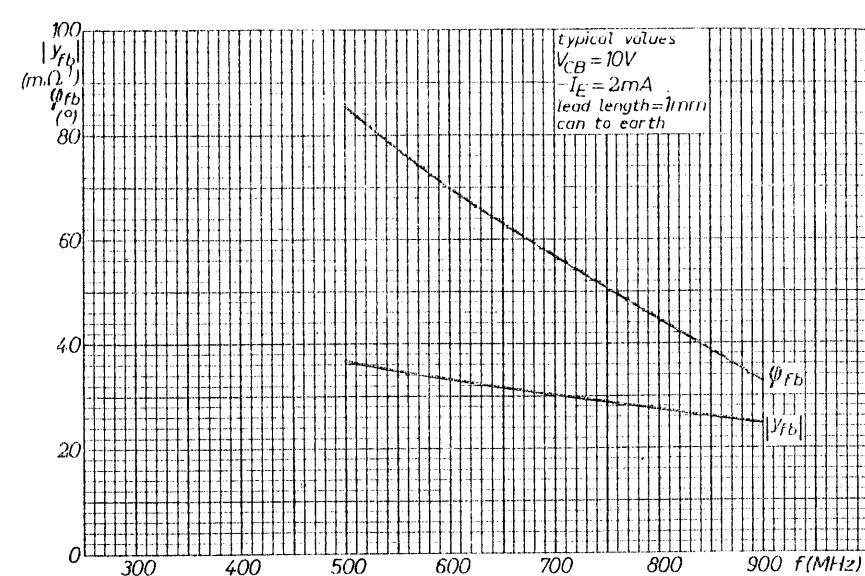
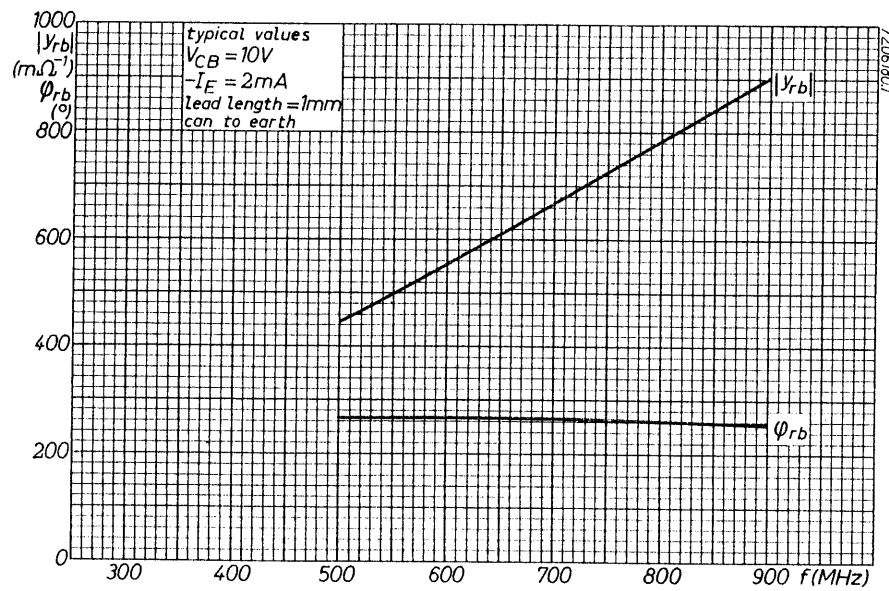
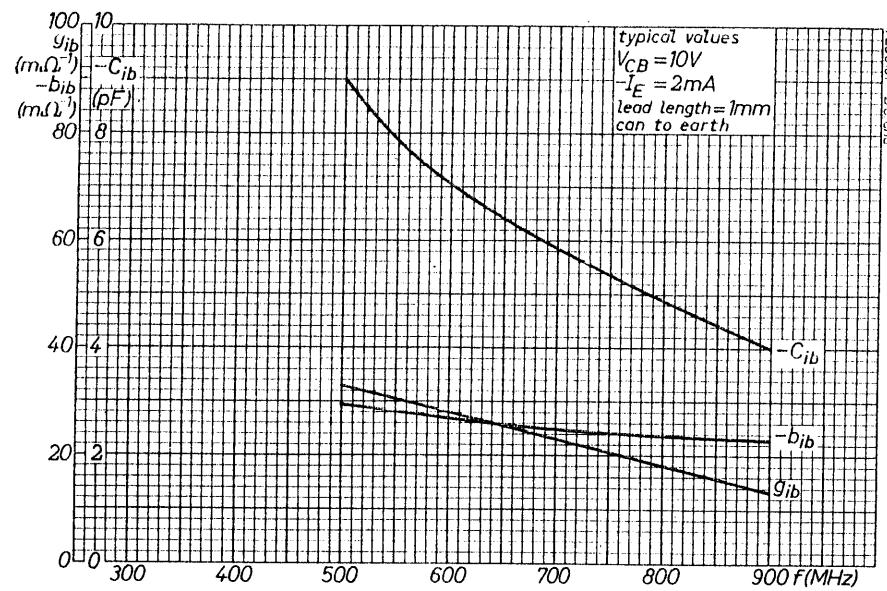
$$G_{UM} = \frac{|y_{fb}|^2}{4 g_{ib} g_{ob}}$$

-I_E = 2 mA; V_{CB} = 10 V; f = 500 MHzG_{UM} typ. 13.5 dB-I_E = 2 mA; V_{CB} = 10 V; f = 900 MHzG_{UM} typ. 11 dBTransducer gain²⁾-I_E = 2 mA; V_{CB} = 10 V; f = 900 MHz;G_S = 20 mΩ⁻¹; B_S = 0G_L = 2 mΩ⁻¹; B_L : tunedG_{tr} typ. 8 dB

¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

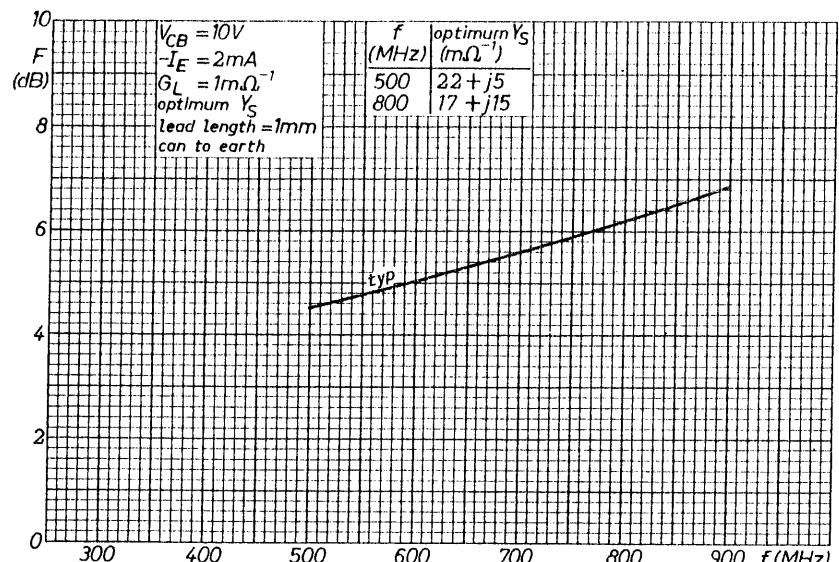
¹⁾ 1 fF = 1 femtofarad = 10⁻¹⁵ F.

²⁾ Common base configuration, metal envelope contacted to earth directly, external lead length: 1 mm.



U.H.F. SILICON PLANAR TRANSISTOR

N-P-N transistor in a TO-72 metal envelope with insulated electrodes and a shield lead connected to the case. The BF182 is primarily intended for application as separate mixer in integrated television tuners.

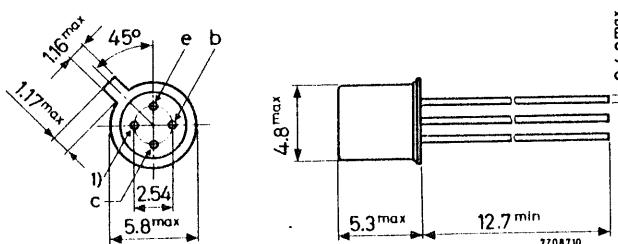


QUICK REFERENCE DATA		
Collector-base voltage (open emitter)	V_{CBO}	max. 25 V
Collector-emitter voltage (open base)	V_{CEO}	max. 20 V
Collector current (d.c.)	I_C	max. 15 mA
Total power dissipation up to $T_{amb} = 25^\circ C$	P_{tot}	max. 150 mW
Junction temperature	T_j	max. 175 $^\circ C$
Transition frequency	f_T	typ. 650 MHz
$I_C = 2 \text{ mA}; V_{CE} = 10 \text{ V}$		
Max. unilateralised power gain	G_{UM}	typ. 11 dB
$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 900 \text{ MHz}$		
Noise figure at optimum source admittance	F	typ. 7.4 dB
$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 800 \text{ MHz}$		

MECHANICAL DATA

TO-72

Dimensions in mm



Accessories available: 56246, 56263

RATINGS (Limiting values)¹⁾Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	3	V

Currents

Collector current (d.c.)	I_C	max.	15	mA
Collector current (peak value)	I_{CM}	max.	15	mA

Power dissipation

Total power dissipation up to $T_{amb} = 25^\circ\text{C}$	P_{tot}	max.	150	mW
--	-----------	------	-----	----

Temperatures

Storage temperature	T_{stg}	-65 to +175	$^\circ\text{C}$
Junction temperature	T_j	max.	175 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th j-a}$	=	1	$^\circ\text{C}/\text{mW}$
--------------------------------------	--------------	---	---	----------------------------

CHARACTERISTICS $T_{amb} = 25^\circ\text{C}$ unless otherwise specifiedBase current

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}$	I_B	typ.	100	μA
$< 200 \text{ }\mu\text{A}$				

Emitter-base voltage²⁾

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}$	$-V_{EB}$	typ.	770	mV
--	-----------	------	-----	----

Transition frequency

$I_C = 2 \text{ mA}; V_{CE} = 10 \text{ V}$	f_T	typ.	650	MHz
---	-------	------	-----	-----

Feedback capacitance at $f = 10.7 \text{ MHz}$

$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$	$-C_{re}$	typ.	330	fF
---	-----------	------	-----	----

CHARACTERISTICS (continued) $T_{amb} = 25^\circ\text{C}$ unless otherwise specifiedOutput conductance at $f = 35 \text{ MHz}$

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}$	g_{ob}	typ.	8	$\mu\Omega^{-1}$
--	----------	------	---	------------------

Transducer gain at $f = 900 \text{ MHz}$ (common base)¹⁾

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}$	G_{tr}	>	8	dB
$G_S = 20 \text{ m}\Omega^{-1}; G_L = 2 \text{ m}\Omega^{-1}$		typ.	10	dB

Max. unilateralised power gain

$$G_{UM} = \frac{|y_{fb}|^2}{4 g_{ib} g_{ob}}$$

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 500 \text{ MHz}$	G_{UM}	typ.	15	dB
---	----------	------	----	----

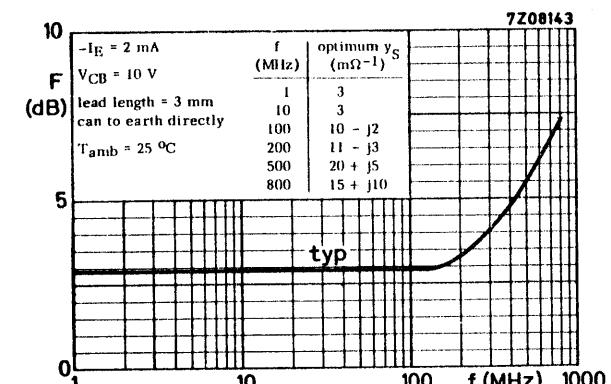
$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 900 \text{ MHz}$	G_{UM}	typ.	11	dB
---	----------	------	----	----

Noise figure at optimum source admittance

$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 200 \text{ MHz}$	F	typ.	3.3	dB
---	-----	------	-----	----

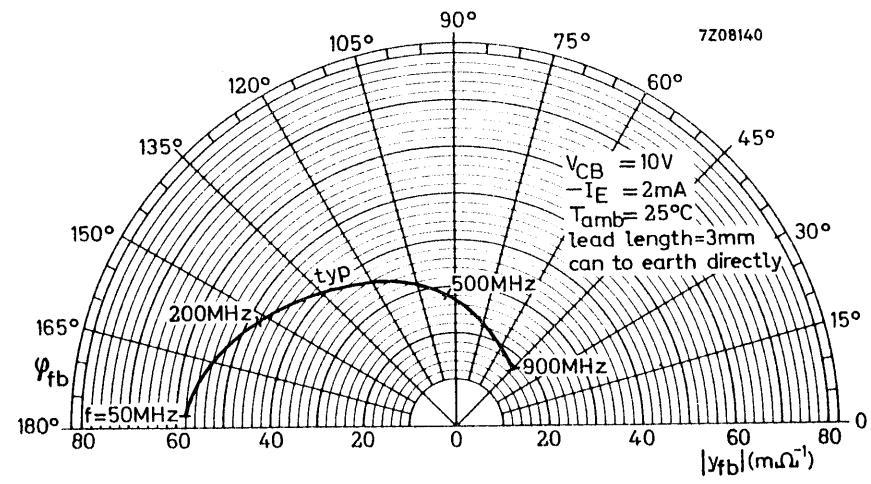
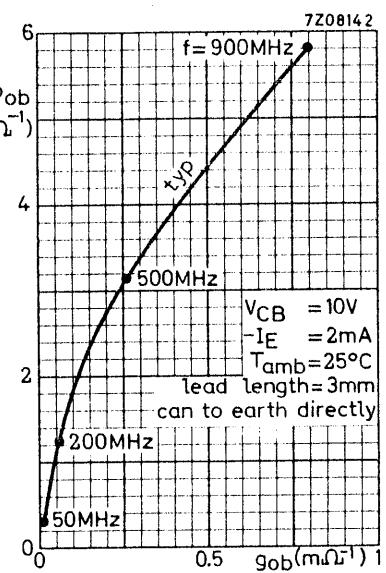
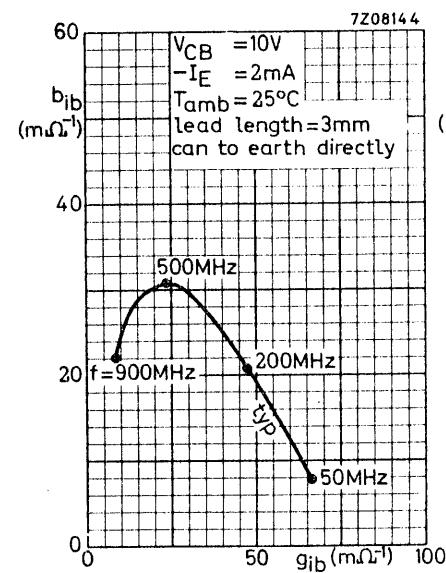
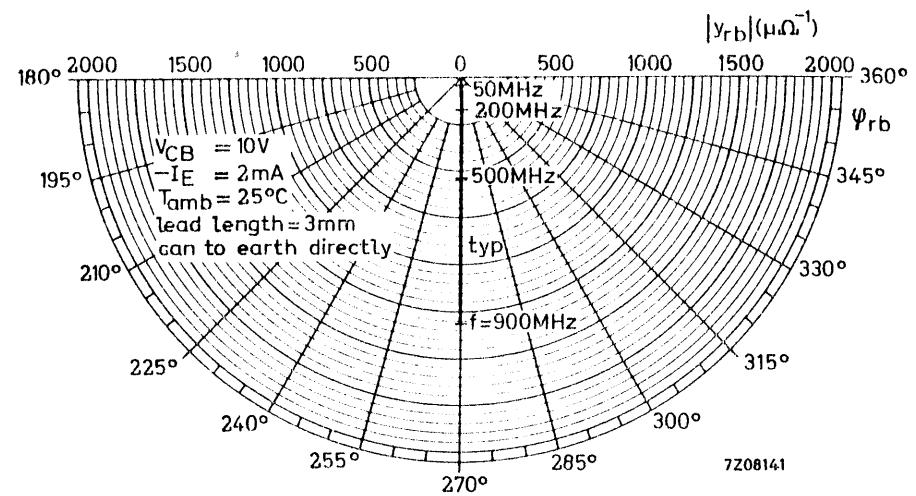
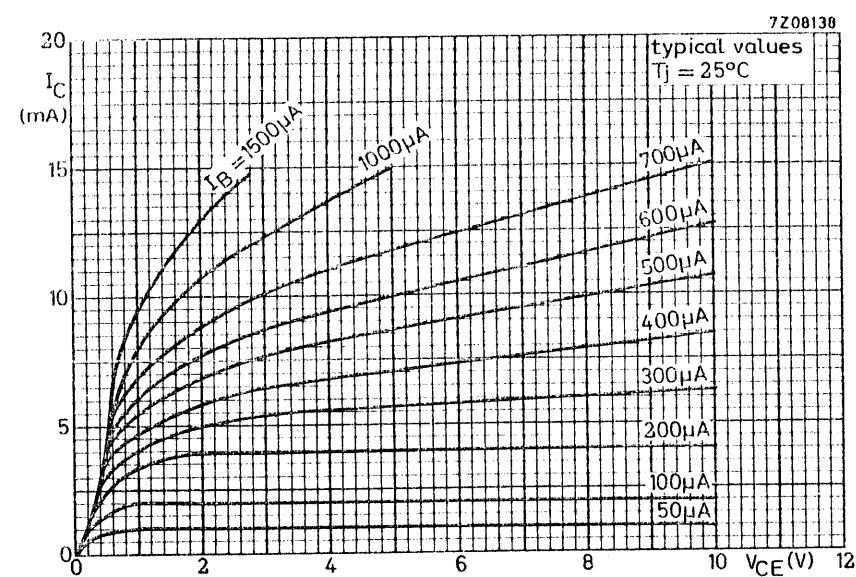
$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 800 \text{ MHz}$	F	typ.	7.4	dB
---	-----	------	-----	----

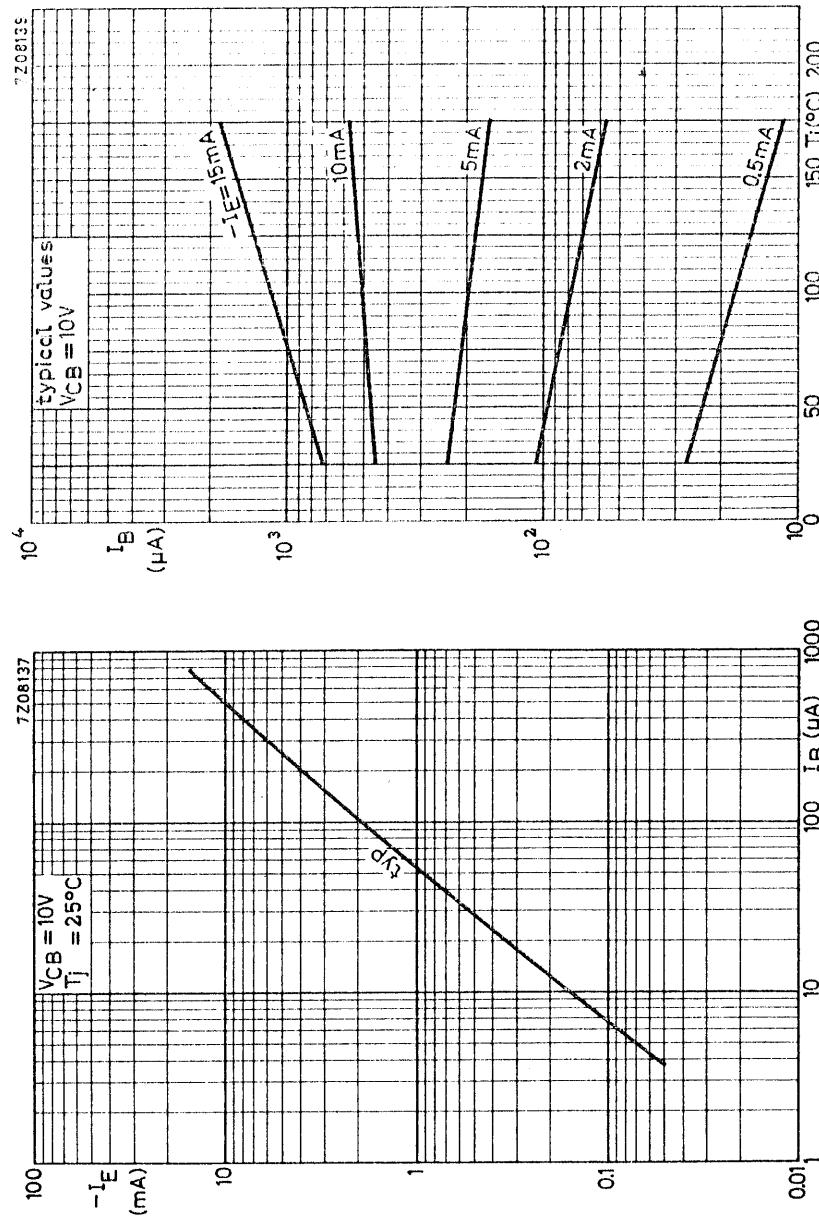
1) Envelope connected to earth directly, lead length = 3 mm.



1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

2) $-V_{EB}$ decreases by about 1.6 mV/ $^\circ\text{C}$ with increasing temperature.





U.H.F. SILICON PLANAR TRANSISTOR

N-P-N transistor in a TO-72 metal envelope with insulated electrodes and a shield lead connected to the case. The BF183 is primarily intended for application in integrated television tuners as local oscillator with excellent frequency stability.

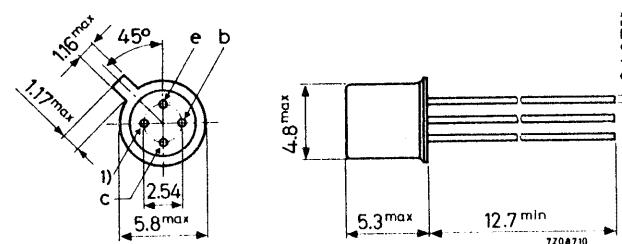
QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector current (d.c.)	I_C	max.	15	mA
Total power dissipation up to $T_{amb} = 25^\circ\text{C}$	P_{tot}	max.	150	mW
Junction temperature	T_j	max.	175	$^\circ\text{C}$
Transition frequency $I_C = 3\text{ mA}; V_{CE} = 10\text{ V}$	f_T	typ.	800	MHz
Max. unilateralised power gain $-I_E = 3\text{ mA}; V_{CB} = 10\text{ V}; f = 900\text{ MHz}$	GUM	typ.	13	dB

MECHANICAL DATA

Dimensions in mm

TO-72



Accessories available: 56246, 56263

RATINGS (Limiting values) ¹⁾Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	25	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Emitter-base voltage (open collector)	V_{EBO}	max.	3	V

Currents

Collector current (d.c.)	I_C	max.	15	mA
Collector current (peak value)	I_{CM}	max.	15	mA

Power dissipation

Total power dissipation up to $T_{amb} = 25^\circ\text{C}$	P_{tot}	max.	150	mW
--	-----------	------	-----	----

Temperatures

Storage temperature	T_{stg}	-65 to +175	$^\circ\text{C}$
Junction temperature	T_j	max.	175 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th j-a}$	=	1	$^\circ\text{C}/\text{mW}$
--------------------------------------	--------------	---	---	----------------------------

CHARACTERISTICS $T_{amb} = 25^\circ\text{C}$ unless otherwise specifiedBase-current

$-I_E = 3 \text{ mA}; V_{CB} = 10 \text{ V}$	I_B	typ. 125 μA
$< 300 \mu\text{A}$		

Emitter-base voltage ¹⁾

$-I_E = 3 \text{ mA}; V_{CB} = 10 \text{ V}$	$-V_{EB}$	typ. 770 mV
--	-----------	-------------

Transition frequency

$I_C = 3 \text{ mA}; V_{CE} = 10 \text{ V}$	f_T	typ. 800 MHz
---	-------	--------------

Feedback capacitance at $f = 10.7 \text{ MHz}$

$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$	$-C_{re}$	typ. 330 fF
---	-----------	-------------

Transducer gain at $f = 900 \text{ MHz}$ (common base) ²⁾

$-I_E = 3 \text{ mA}; V_{CB} = 10 \text{ V}$	G_{tr}	$> 8.5 \text{ dB}$
$G_S = 20 \text{ m}\Omega^{-1}; G_L = 2 \text{ m}\Omega^{-1}$		typ. 12 dB

Max. unilateralised power gain

$G_{UM} = \frac{ y_{fb} ^2}{4 g_{ib} g_{ob}}$	G_{UM}	typ. 16 dB
$-I_E = 3 \text{ mA}; V_{CB} = 10 \text{ V}; f = 500 \text{ MHz}$		
$-I_E = 3 \text{ mA}; V_{CB} = 10 \text{ V}; f = 900 \text{ MHz}$	G_{UM}	typ. 13 dB

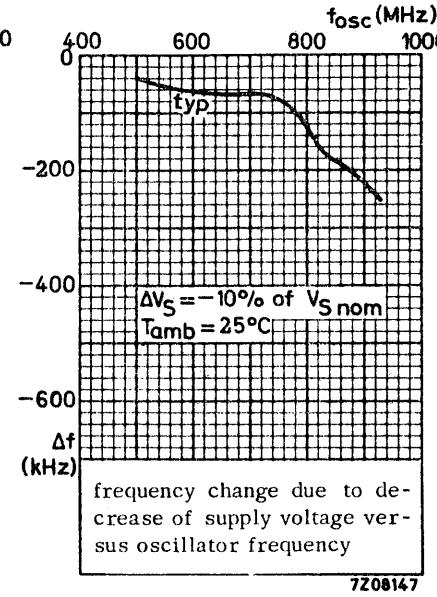
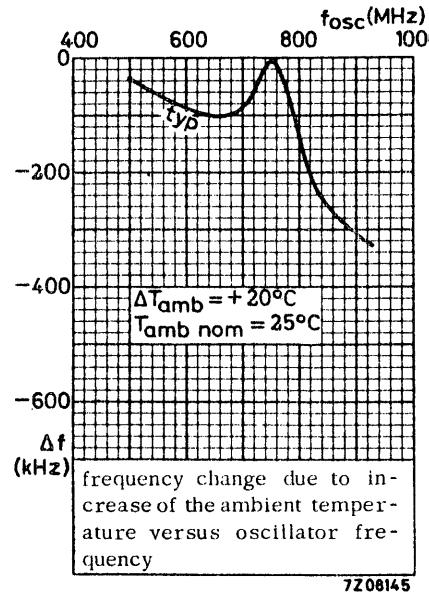
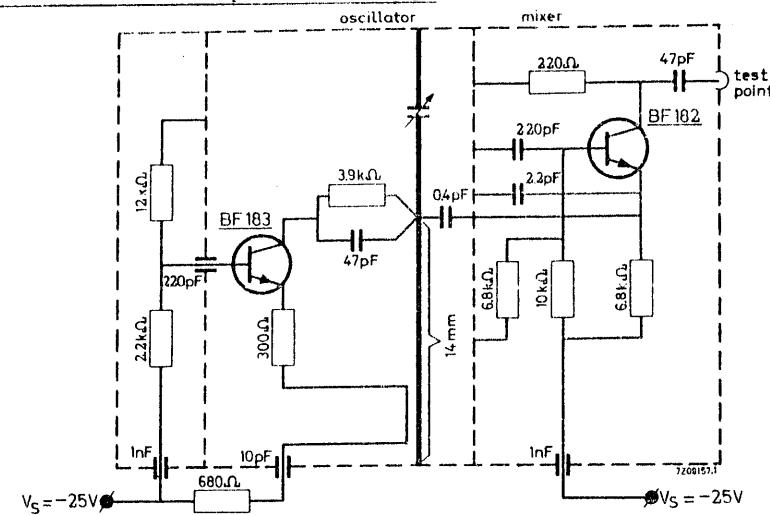
¹⁾) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

¹⁾) $-V_{EB}$ decreases by about 1.6 mV/ $^\circ\text{C}$ with increasing temperature.

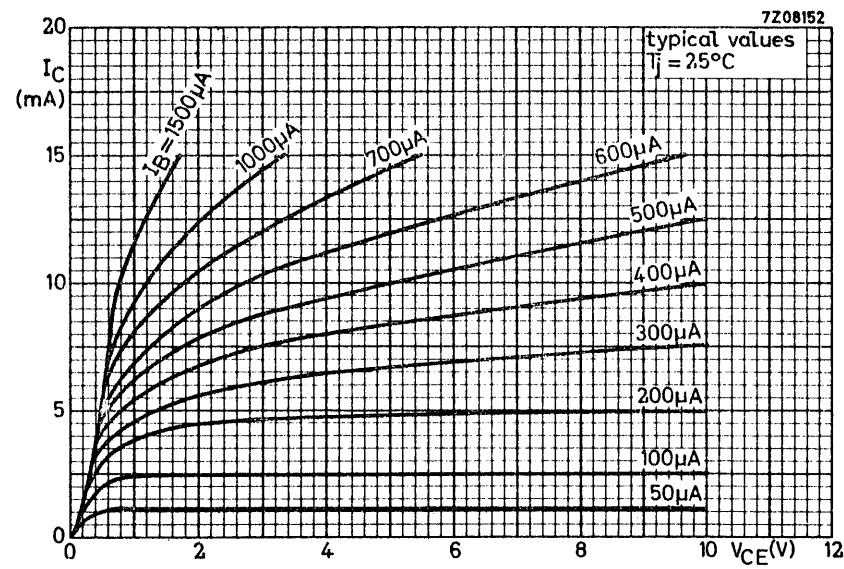
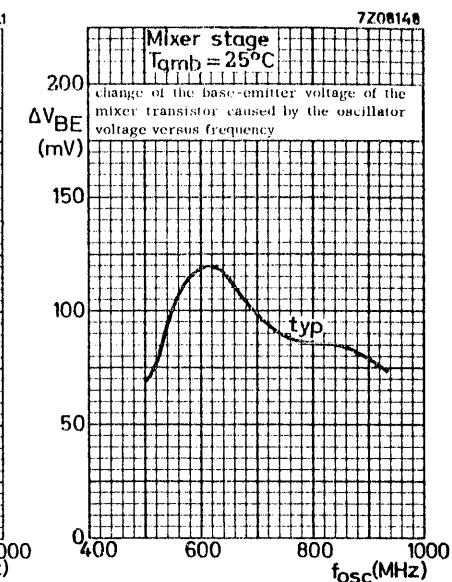
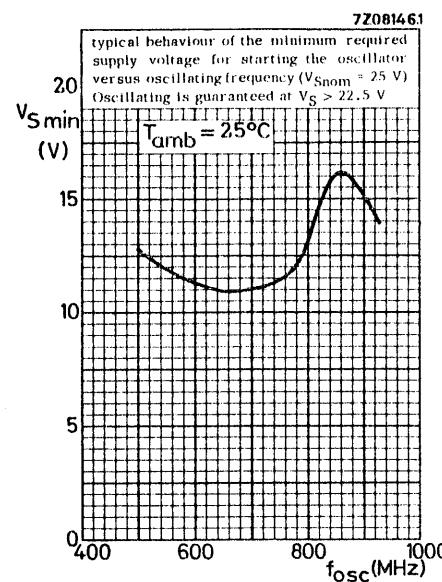
²⁾) Envelope connected to earth directly, lead length = 3 mm.

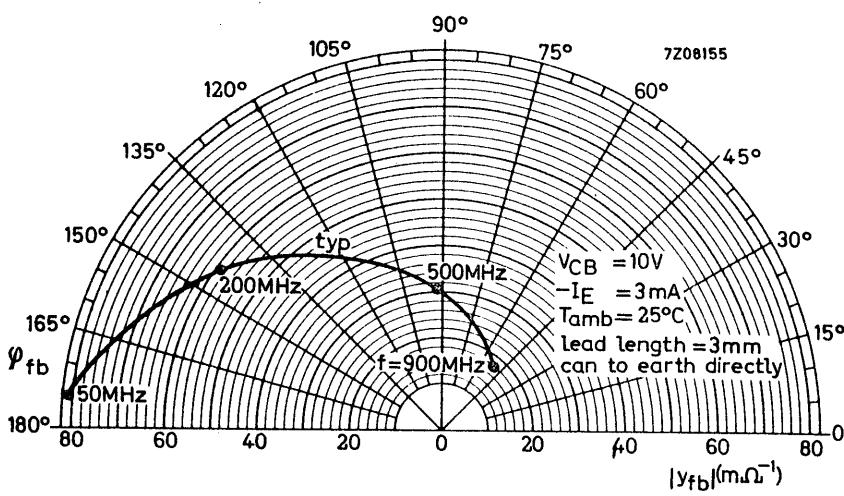
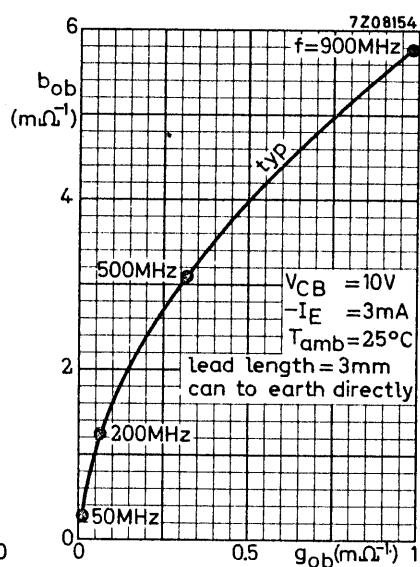
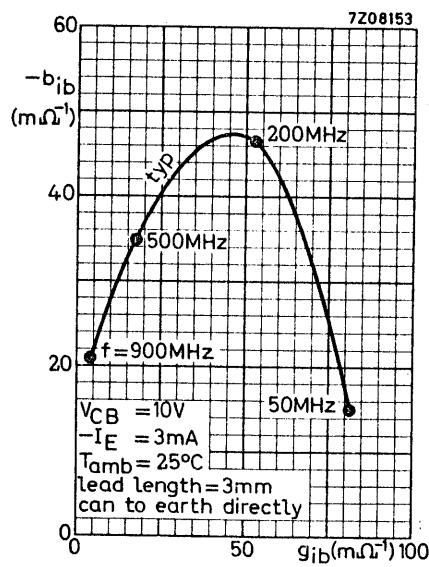
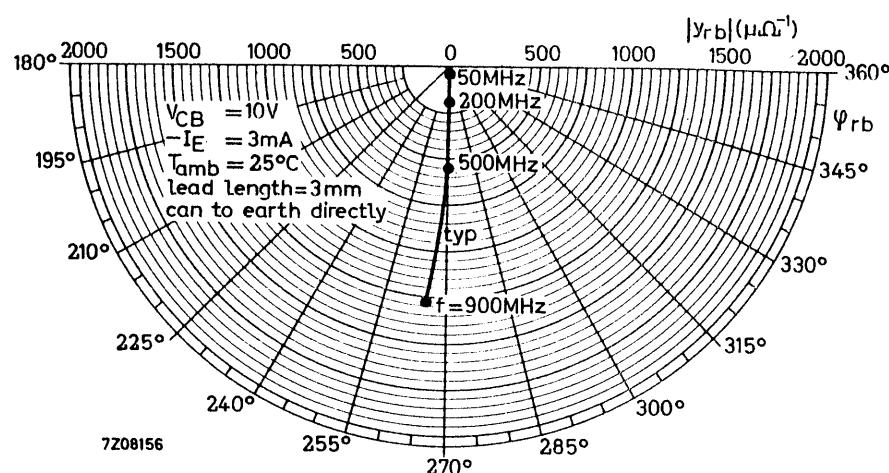
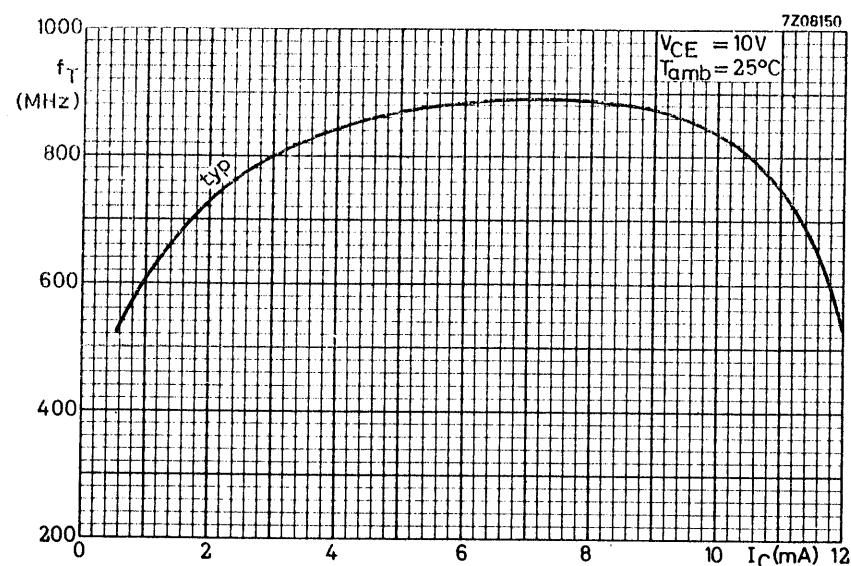
APPLICATION INFORMATION

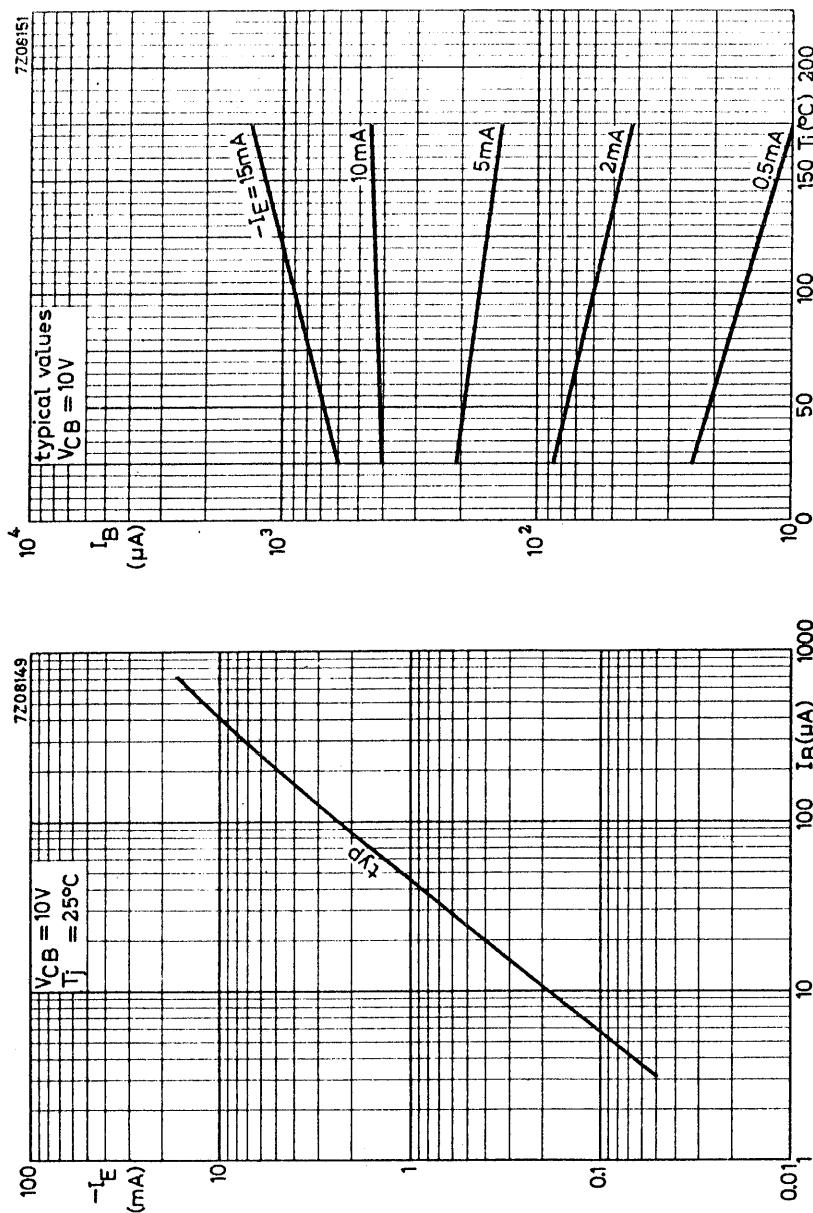
Oscillator circuit with simplified mixer stage



APPLICATION INFORMATION bulletin available on request







SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a TO-72 metal case with insulated electrodes and a shield lead connected to the case; the same transistor is available in lock-fit encapsulation under the type number BF194.

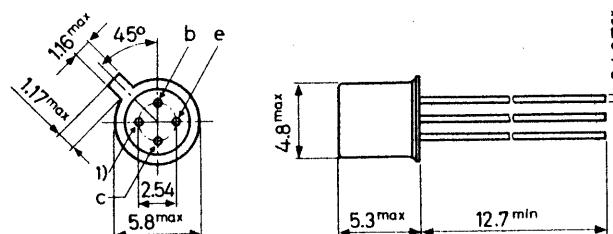
The BF184 is intended for h.f. applications in radio and television receivers; it is especially recommended for f.m. tuners, low noise a.m. mixer-oscillators with high source impedance and i.f. amplifiers in a.m./f.m. receivers where a high current gain is of importance.

QUICK REFERENCE DATA		
Collector-base voltage (open emitter)	V _{CBO}	max. 30 V
Collector-emitter voltage (open base)	V _{CEO}	max. 20 V
Collector current (d.c.)	I _C	max. 30 mA
Total power dissipation up to T _{amb} = 45 °C	P _{tot}	max. 145 mW
Junction temperature	T _j	max. 175 °C
D.C. current gain at T _j = 25 °C		
I _C = 1 mA; V _{CE} = 10 V	h _{FE}	typ. 115
Transition frequency		
I _C = 1 mA; V _{CE} = 10 V	f _T	typ. 300 MHz

MECHANICAL DATA

TO-72
Insulated electrodes

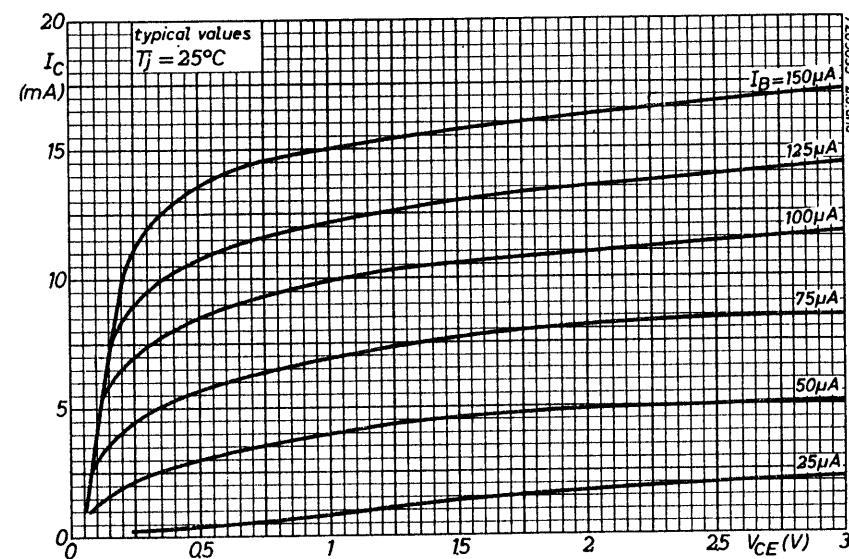
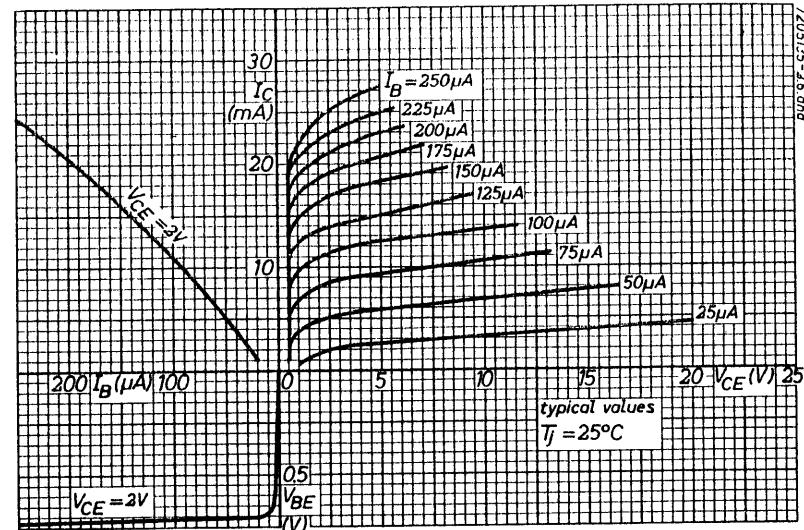
Dimensions in mm

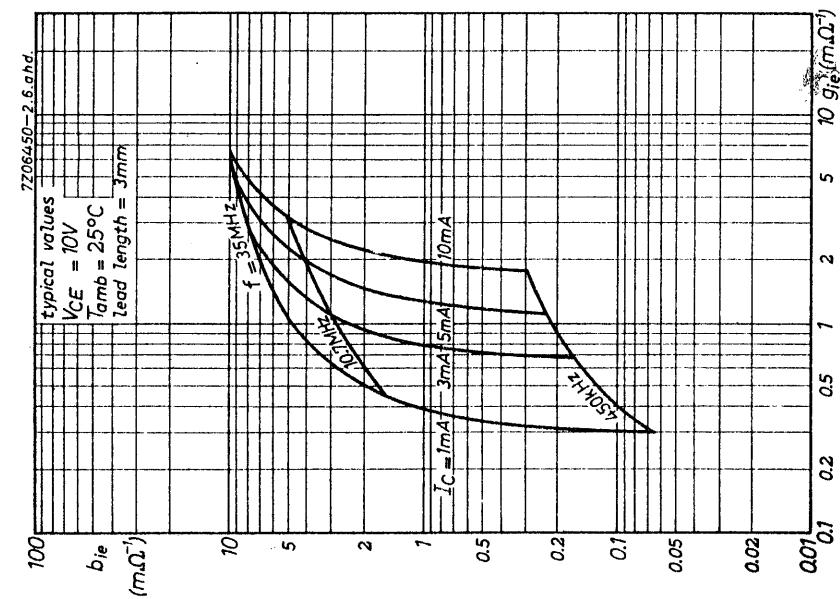
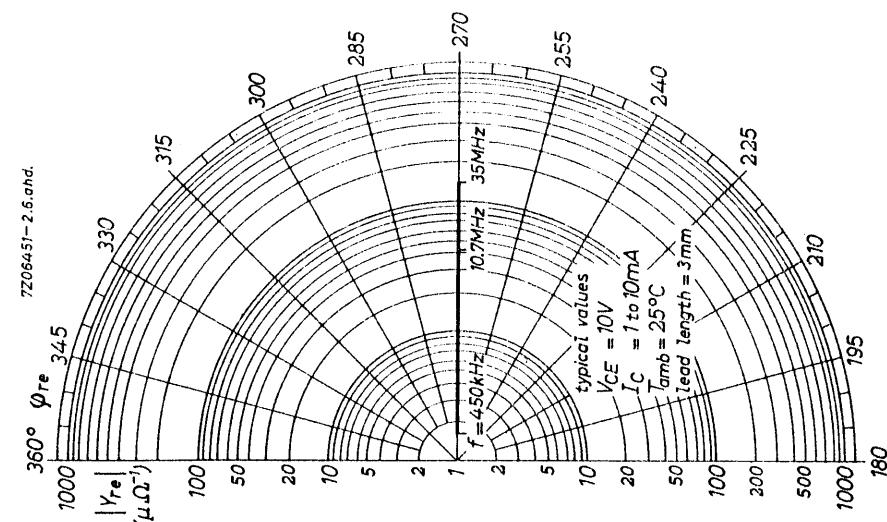
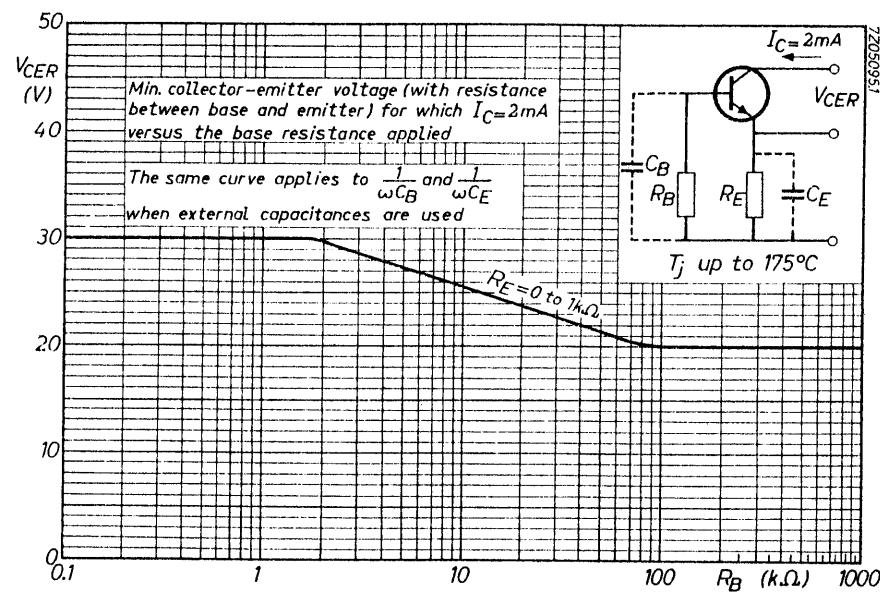
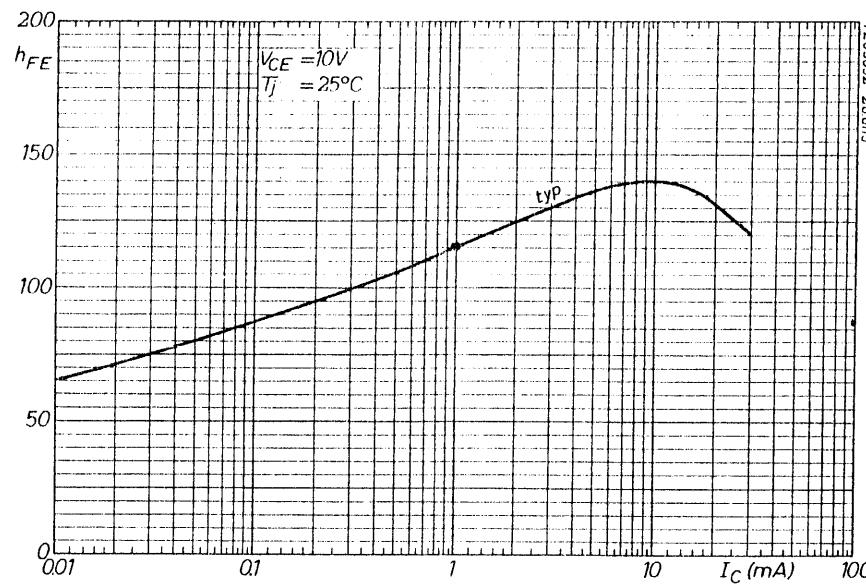


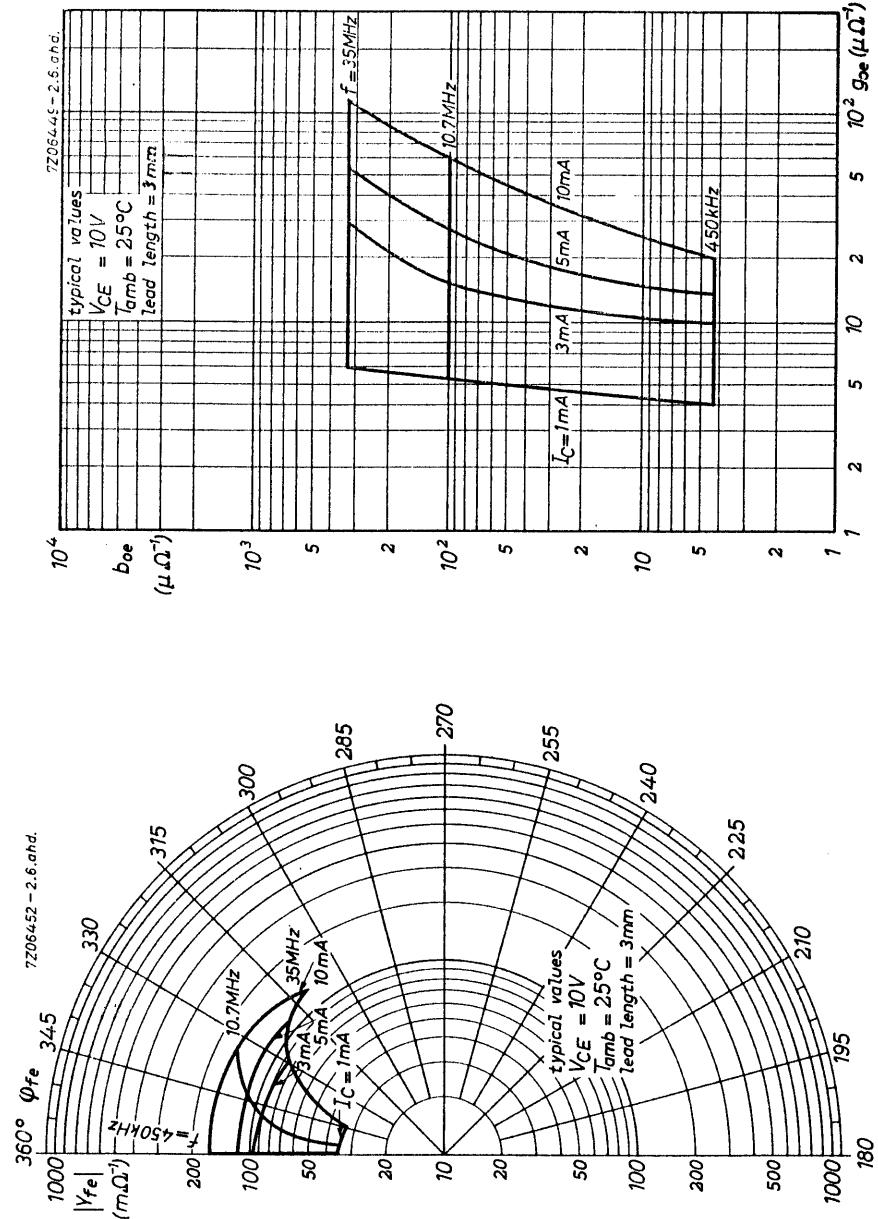
Accessories available: 56246, 56263.

RATINGS (Limiting values) ¹⁾VoltagesCollector-base voltage (open emitter) V_{CBO} max. 30 VCollector-emitter voltage (open base)
(See also sheet 4) V_{CEO} max. 20 VEmitter-base voltage (open collector) V_{EBO} max. 5 VCurrentsCollector current (d.c.) I_C max. 30 mACollector current (peak value) I_{CM} max. 30 mAPower dissipationTotal power dissipation up to $T_{amb} = 45^{\circ}\text{C}$ P_{tot} max. 145 mWTemperaturesStorage temperature T_{stg} -65 to $+175^{\circ}\text{C}$ Junction temperature T_j max. 175°C **THERMAL RESISTANCE**From junction to ambient in free air $R_{th j-a} = 0.9^{\circ}\text{C}/\text{mW}$ **CHARACTERISTICS** $T_j = 25^{\circ}\text{C}$ unless otherwise specifiedBase-emitter voltage ²⁾ $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ V_{BE} 0.65 to 0.74 V
 $I_C = 20 \text{ mA}; V_{CE} = 2 \text{ V}$ V_{BE} < 1.0 VFeedback capacitance at $f = 0.45 \text{ MHz}$ $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ $-C_{re}$ typ. 0.65 pFD.C. current gain $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ h_{FE} 75 to 750 typ. 115Transition frequency $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ f_T typ. 300 MHzConversion noise figure $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ F_c typ. 3 dB
 $G_S = 0.6 \text{ m}\Omega^{-1}; f = 0.2 \text{ MHz}$ F_c typ. 2 dB
 $G_S = 1.2 \text{ m}\Omega^{-1}; f = 1.0 \text{ MHz}$

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

2) V_{BE} decreases with about 1.7 mV/ $^{\circ}\text{C}$ at increasing temperature.





SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a TO-72 metal case with insulated electrodes and a shield lead connected to the case; the same transistor is available in lock-fit encapsulation under the type number BF195.

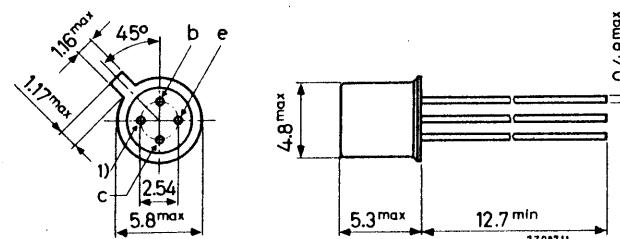
The BF185 is intended for h.f. applications in radio and television receivers; it is especially recommended for f.m. tuners, i.f. amplifiers in a.m./f.m. receivers where a low transistor output conductance is of importance, a.m. input stages of car radios where a low noise figure at low source impedance is required.

QUICK REFERENCE DATA		
Collector-base voltage (open emitter)	V_{CBO}	max. 30 V
Collector-emitter voltage (open base)	V_{CEO}	max. 20 V
Collector current (d.c.)	I_C	max. 30 mA
Total power dissipation up to $T_{amb} = 45^\circ\text{C}$	P_{tot}	max. 145 mW
Junction temperature	T_j	max. 175 $^\circ\text{C}$
D.C. current gain at $T_j = 25^\circ\text{C}$ $I_C = 1\text{ mA}; V_{CE} = 10\text{ V}$	h_{FE}	typ. 67
Transition frequency $I_C = 1\text{ mA}; V_{CE} = 10\text{ V}$	f_T	typ. 220 MHz
Noise figure at $f = 100\text{ MHz}$ $I_C = 1\text{ mA}; V_{CE} = 10\text{ V}; G_S = 10\text{ m}\Omega^{-1}$	F	typ. 4 dB

MECHANICAL DATA

TO-72
Insulated electrodes

Dimensions in mm



1) = shield lead (connected to case)

Accessories available: 56246, 56263.

RATINGS (Limiting values) ¹⁾**Voltages**Collector-base voltage (open emitter) V_{CBO} max. 30 VCollector-emitter voltage (open base)
(See also sheet 8) V_{CEO} max. 20 VEmitter-base voltage (open collector) V_{EBO} max. 5 V**Currents**Collector current (d.c.) I_C max. 30 mACollector current (peak value) I_{CM} max. 30 mA**Power dissipation**Total power dissipation up to $T_{amb} = 45^{\circ}\text{C}$ P_{tot} max. 145 mW**Temperatures**Storage temperature T_{stg} -65 to $+175^{\circ}\text{C}$ Junction temperature T_j max. 175°C **THERMAL RESISTANCE**From junction to ambient in free air $R_{th\ j-a}$ = 0.9 $^{\circ}\text{C}/\text{mW}$ **CHARACTERISTICS** $T_j = 25^{\circ}\text{C}$ unless otherwise specified**Base-emitter voltage ²⁾** $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ V_{BE} 0.65 to 0.74 V $I_C = 20 \text{ mA}; V_{CE} = 2 \text{ V}$ V_{BE} < 1.0 V**Feedback capacitance at $f = 0.45 \text{ MHz}$** $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ $-C_{re}$ typ. 0.65 pF**D.C. current gain** $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ h_{FE} 34 to 140

typ. 67

Transition frequency $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ f_T typ. 220 MHz¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.²⁾ V_{BE} decreases with about 1.7 mV/ $^{\circ}\text{C}$ at increasing temperature.**CHARACTERISTICS (continued)** $T_j = 25^{\circ}\text{C}$ unless otherwise specified**Noise figure** $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ $f = 0.2 \text{ MHz}; G_S = 5 \text{ m}\Omega^{-1}$ $f = 1 \text{ MHz}; G_S = 20 \text{ m}\Omega^{-1}$ $f = 100 \text{ MHz}; G_S = 10 \text{ m}\Omega^{-1}$

F typ. 2 dB

F typ. 3.5 dB

F typ. 4 dB

y parameters at $f = 100 \text{ MHz}$ (common base) $-I_E = 1 \text{ mA}; V_{CB} = 10 \text{ V}$ g_{ib} typ. 33 $\text{m}\Omega^{-1}$

Input conductance

-C_{ib} typ. 5.5 pF

Input capacitance

|y_{rb}| typ. 220 $\mu\Omega^{-1}$

Feedback admittance

φ_{rb} typ. 273°

Phase angle of feedback admittance

|y_{fb}| typ. 33 $\text{m}\Omega^{-1}$

Transfer admittance

φ_{fb} typ. 150°

Phase angle of transfer admittance

g_{ob} typ. 12 $\mu\Omega^{-1}$

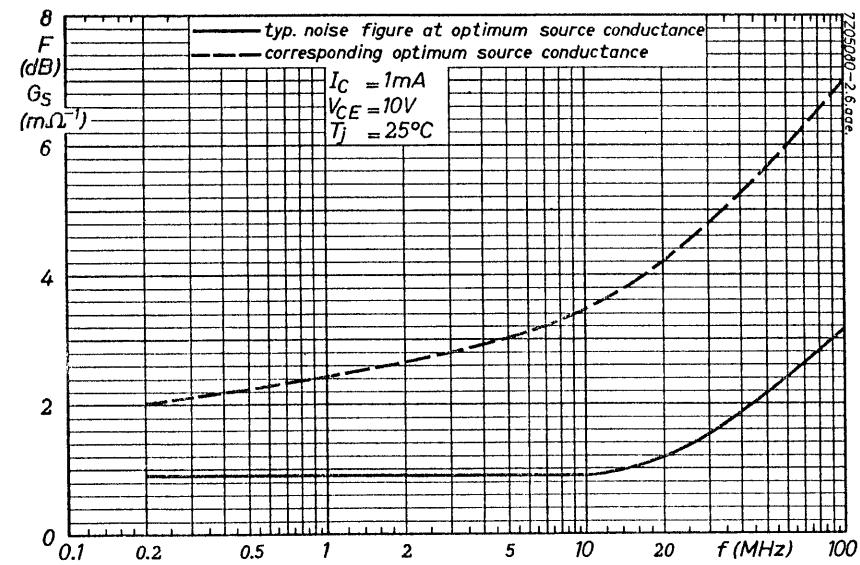
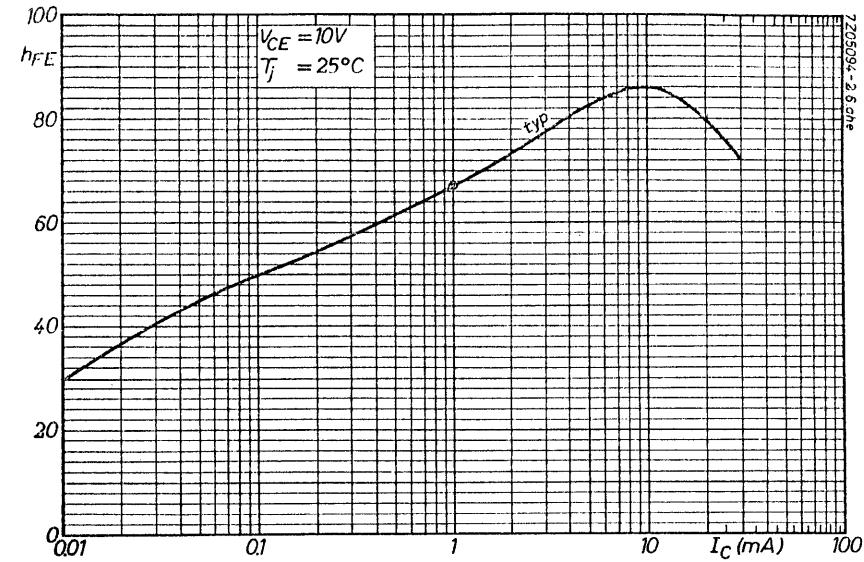
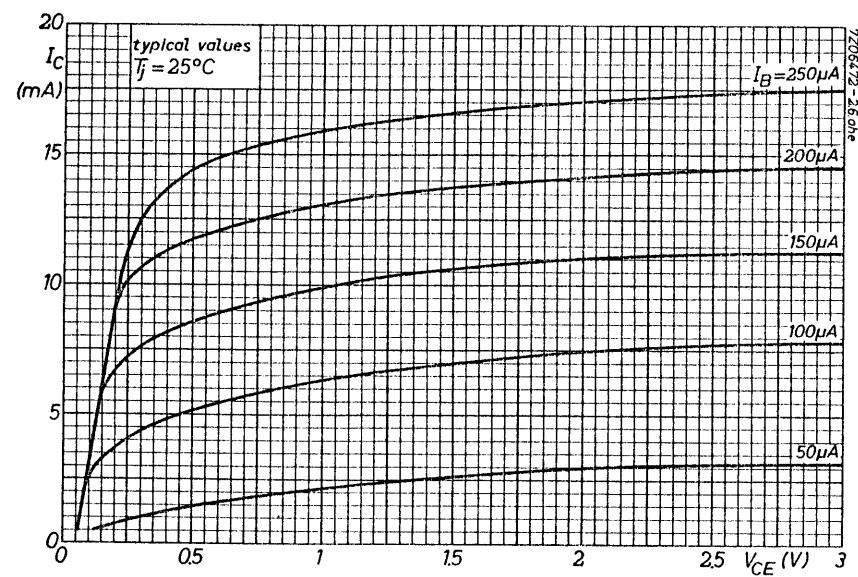
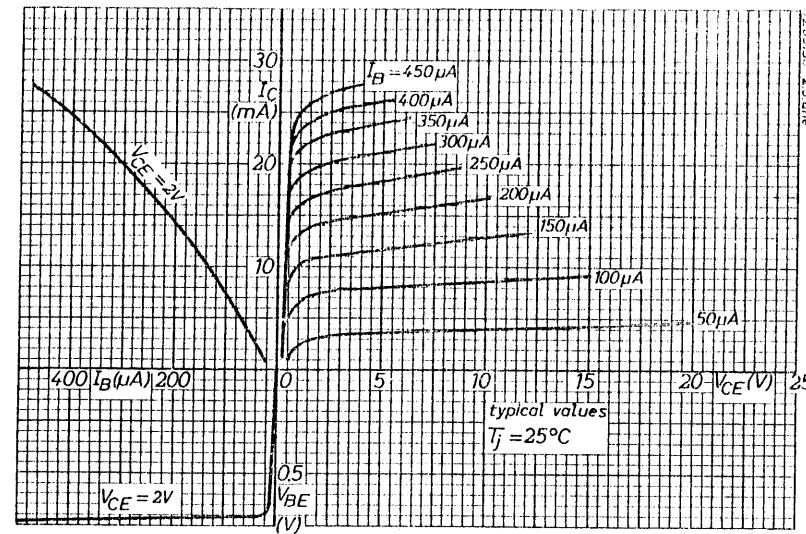
Output conductance

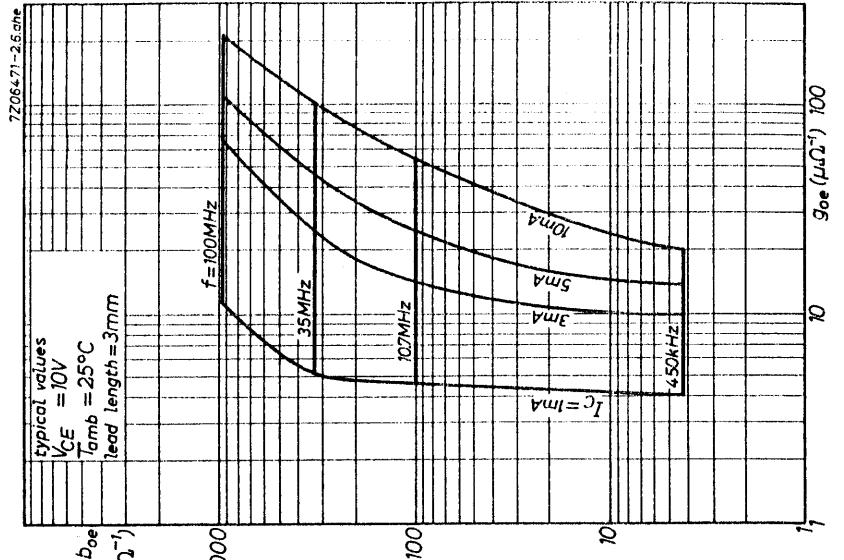
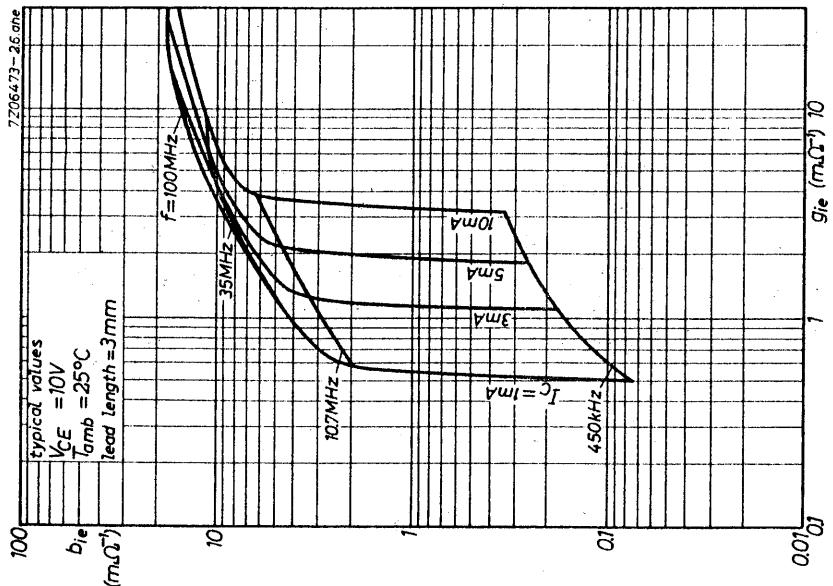
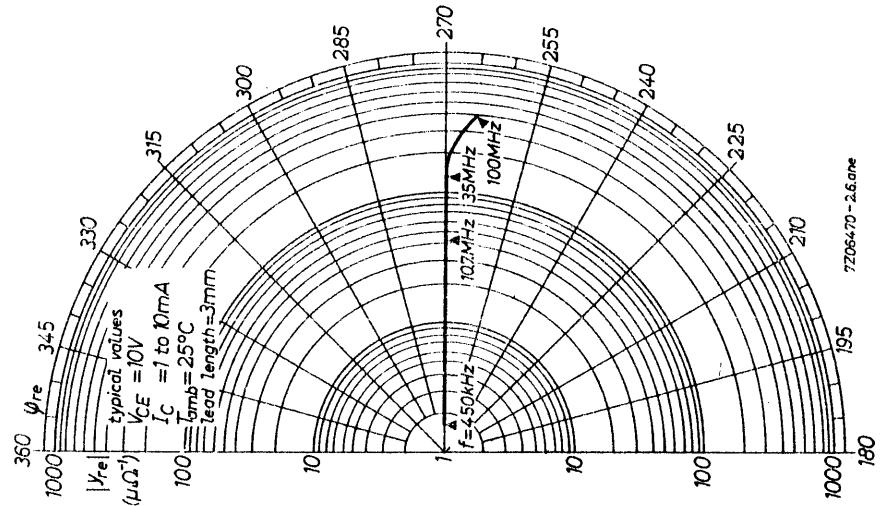
C_{ob} typ. 1.5 pF

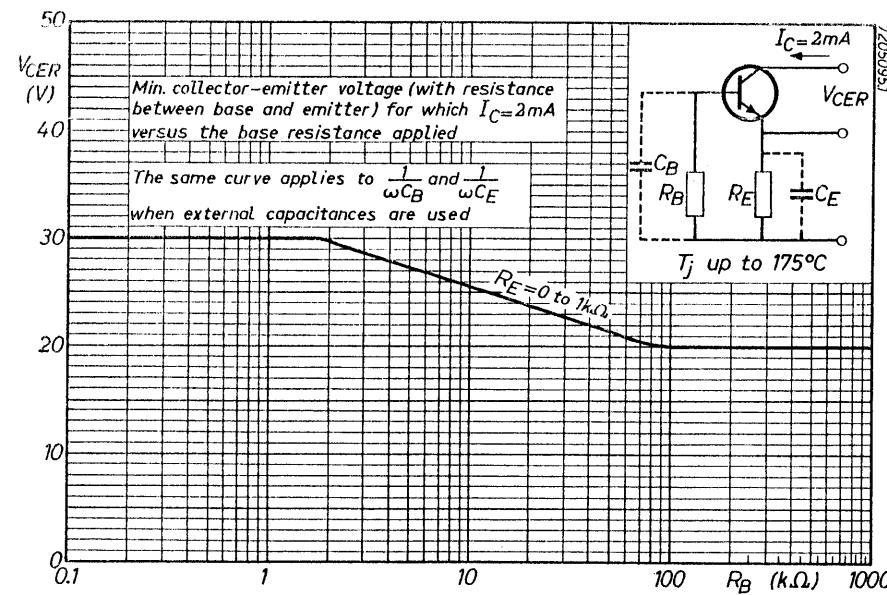
Output capacitance

NOTE

All small signal quantities have been measured with a length of leads between the bottom of the transistor and measuring jig of 3 mm.







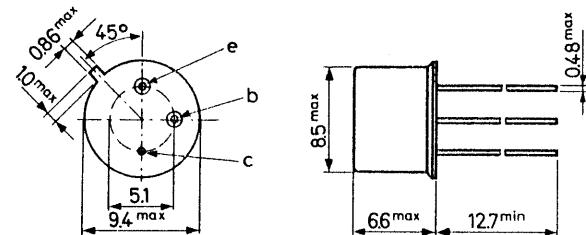
SILICON PLANAR TRANSISTOR FOR LUMINANCE AMPLIFIERS

N-P-N transistor in a TO-39 metal envelope with the collector connected to the case. The BF186 is intended for use in the output stage of the luminance amplifier in colour television receivers.

QUICK REFERENCE DATA		
Collector-base voltage (open emitter)	V _{CBO}	max. 190 V
Collector-emitter voltage ($R_B \leq 1\text{k}\Omega$)	V _{CER}	max. 190 V
Collector current (peak value)	I _{CM}	max. 60 mA
Total power dissipation up to $T_{\text{amb}} = 55^\circ\text{C}$ up to $T_{\text{mb}} = 145^\circ\text{C}$	P _{tot}	max. 0.725 W max. 2.75 W
Junction temperature	T _j	max. 200 °C
D.C. current gain at $T_j = 25^\circ\text{C}$		
$I_C = 40 \text{ mA}; V_{CE} = 20 \text{ V}$	h _{FE}	> 20
Transition frequency	f _T	typ. 120 MHz
Feedback capacitance		
$I_C = 10 \text{ mA}; V_{CE} = 20 \text{ V}$	-C _{re}	typ. 1.8 pF

MECHANICAL DATA

Collector connected to case
TO-39



Accessories available: 56218; 56245; 56265

MOUNTING METHOD see page 4

RATINGS (Limiting values)¹⁾Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	190	V ²⁾
Collector-emitter voltage ($R_B \leq 1 \text{ k}\Omega$)	V_{CER}	max.	190	V ²⁾
Emitter-base voltage (open collector)	V_{EBO}	max.	5	V

Currents

Collector current (d.c.)	I_C	max.	60	mA
Collector current (peak value)	I_{CM}	max.	60	mA

Power dissipation

Total power dissipation up to $T_{amb} = 55^\circ\text{C}$ (in free air)	P_{tot}	max.	0.725	W
$T_{mb} = 145^\circ\text{C}$	P_{tot}	max.	2.75	W

Temperatures

Storage temperature	T_{stg}	-55 to +175	$^\circ\text{C}$
Junction temperature	T_j	max.	200 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th j-a}$	=	200	$^\circ\text{C/W}$
From junction to mounting base	$R_{th j-mb}$	=	20	$^\circ\text{C/W}$ ³⁾

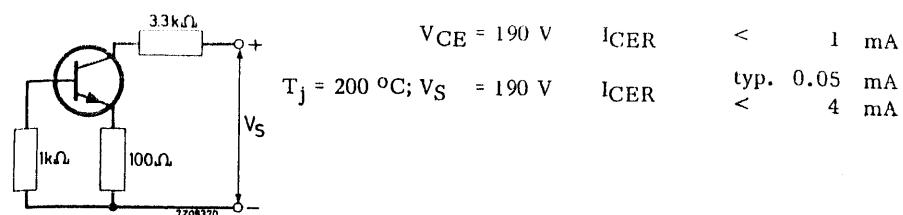
1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

→ 2) During switching on, a supply voltage of 1.2 times the rated V_{CER} value is permitted. The current must be limited so that maximum dissipation and maximum junction temperature are not exceeded (see page 8).

3) See also page 4.

CHARACTERISTICS

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

Collector cut-off current

$V_{CE} = 190 \text{ V}$ ICER < 1 mA
 $T_j = 200^\circ\text{C}; V_S = 190 \text{ V}$ ICER typ. 0.05 mA
 $< 4 \text{ mA}$

Base current

$I_C = 40 \text{ mA}; V_{CE} = 20 \text{ V}$ IB typ. 0.8 mA
 $< 2 \text{ mA}$

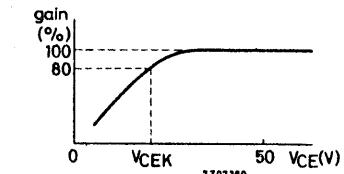
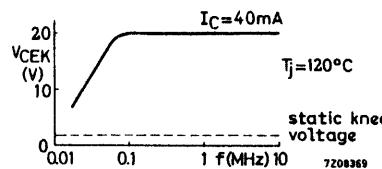
Base-emitter voltage¹⁾

$I_C = 40 \text{ mA}; V_{CE} = 20 \text{ V}$ VBE typ. 0.75 V
 $< 1.2 \text{ V}$

High frequency knee voltage at $T_j = 120^\circ\text{C}$

$I_C = 40 \text{ mA}$ (see also page 7) VCEK typ. 20 V

The high frequency knee voltage of a transistor is that value of the collector-emitter voltage at which the small signal gain, measured in a practical circuit, has dropped to 80% of the gain at $V_{CE} = 50 \text{ V}$. A further decrease of the collector-emitter voltage results in a rapid increase of the distortion of the signal.

Feedback capacitance at $f = 0.5 \text{ MHz}$

$I_C = 10 \text{ mA}; V_{CE} = 20 \text{ V}$ -C_{re} typ. 1.8 pF
 $< 3.5 \text{ pF}$

Feedback time constant at $f = 10 \text{ MHz}$

$-I_E = 10 \text{ mA}; V_{CB} = 10 \text{ V}$ r_{bb'}C_{b'c} typ. 30 ps
 $< 100 \text{ ps}$

Transition frequency

$I_C = 10 \text{ mA}; V_{CE} = 10 \text{ V}$ f_T typ. 120 MHz

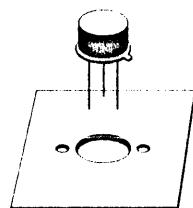
1) V_{BE} decreases by about 1.6 mV/ $^\circ\text{C}$ with increasing temperature.

MOUNTING METHOD

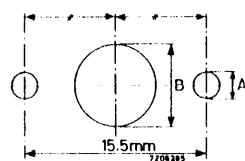
Transistor mounted directly on a heatsink ($R_{th\ j-mb} = 20\ ^\circ C/W$)

$R_{th\ mb-h} \approx 3\ ^\circ C/W$

clamping washer of insulating material from accessory 56216



Fasten with M2.6 bolts



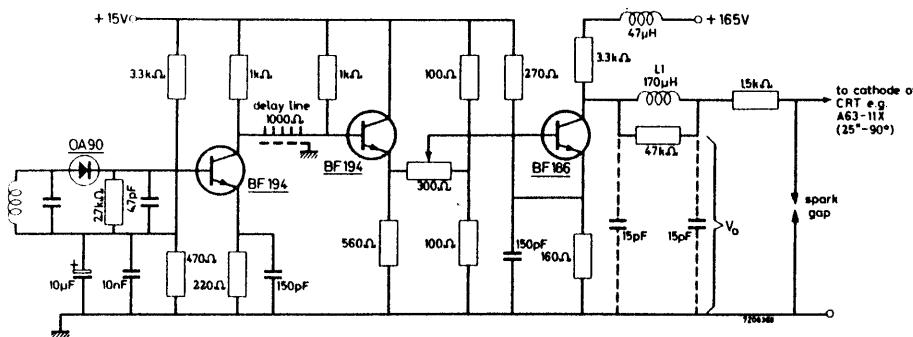
Diameter A: 2.8 mm

Diameter B: min. 7.0 mm
max. 7.7 mm

Recommended bore plan

APPLICATION INFORMATION

The BF186 used in the output stage of a three stage luminance video amplifier for a large screen colour television receiver.



APPLICATION INFORMATION (continued)

Performance up to $T_{amb} = 55\ ^\circ C$

Voltage gain

$G_V = 60$

Output voltage (video information)

$V_o = 105\ V$

Bandwidth (3 dB)

$B > 4\ MHz$

Transient response

rise time

$t_r = 80\ ns$

fall time

$t_f = 80\ ns$

overshoot

< 5 %

Gain linearity

> 90 %

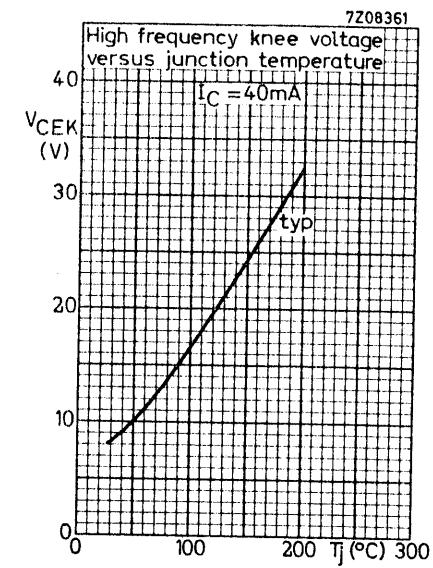
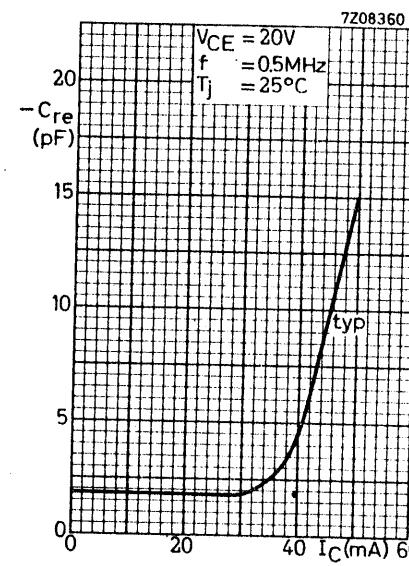
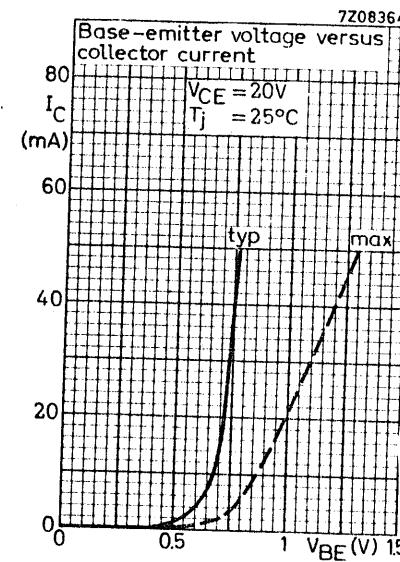
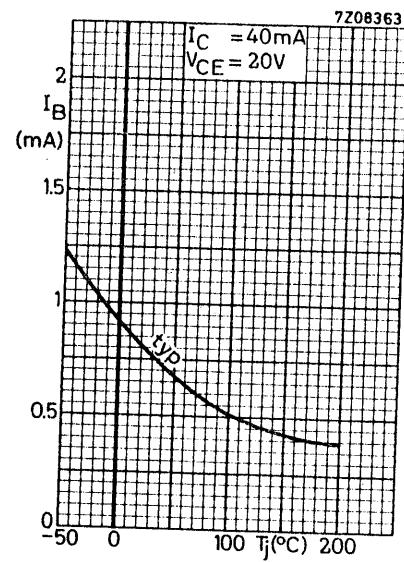
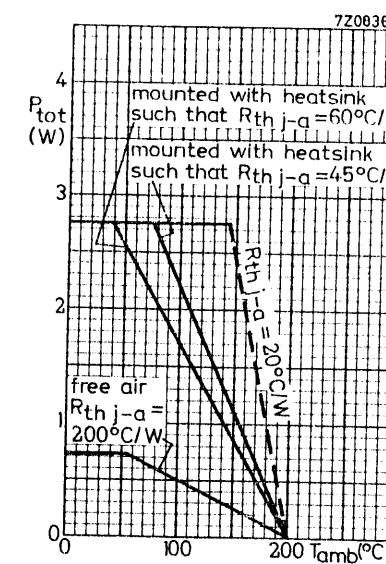
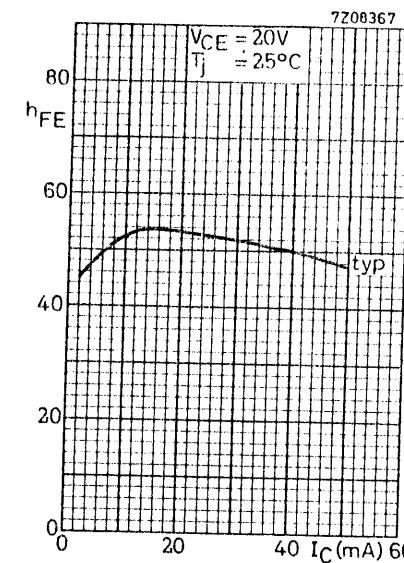
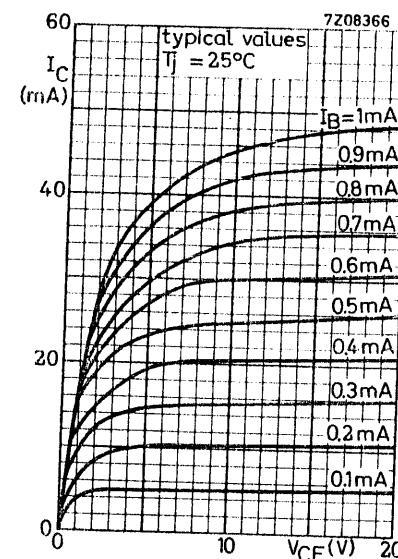
Notes

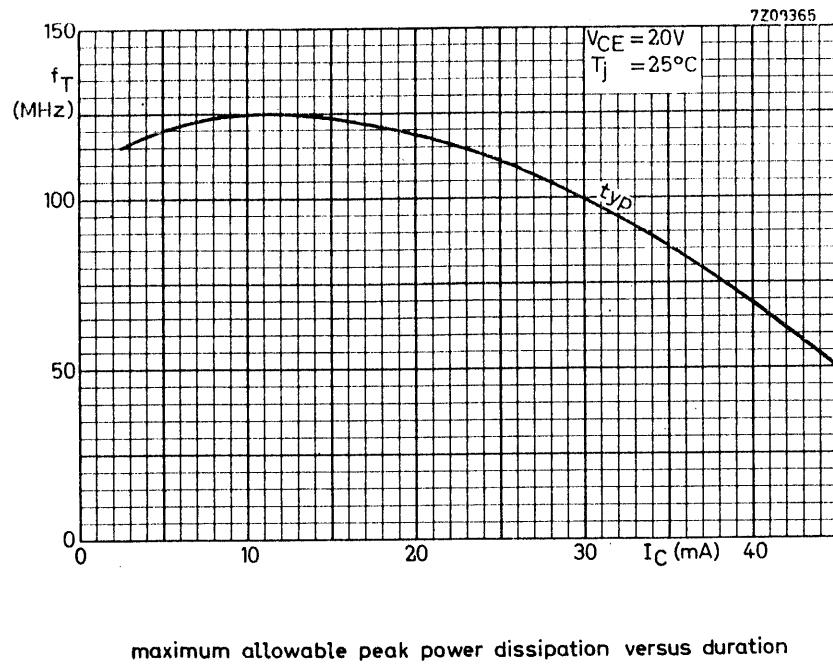
- For good frequency response L1 should be mounted near to the picture tube in order to obtain a load capacitance of $\approx 15\ pF$ on each side of L1.
- Delay line:

delay time	450 ns ($\pm 5\%$)
rise time	60 ns
impedance	1000 Ω ($\pm 10\%$)

e.g. AT4080/00
- In order to ensure the specified performance up to $T_{amb} = 55\ ^\circ C$, the junction temperature of the BF186 should not exceed $120\ ^\circ C$ at nominal supply voltage (temperature dependency of high frequency knee voltage, see page 7). Therefore the thermal resistance $R_{th\ j-a}$ should be $\leq 45\ ^\circ C/W$.
- The contribution of the heatsink to the total output capacitance of the device should not exceed $4\ pF$, to ensure the above mentioned performance for bandwidth and transient response.

APPLICATION INFORMATION bulletins available on request





SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a plastic envelope with stiff, self-locking pins suitable for use with standard printed boards.

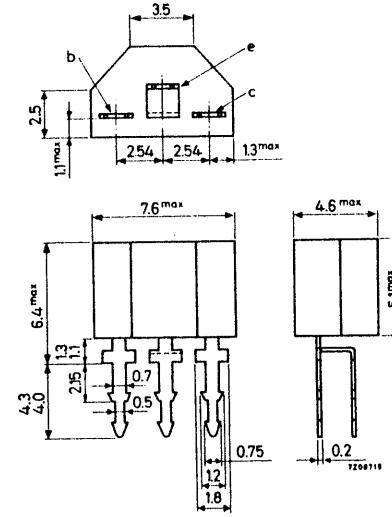
The BF194 is intended for h.f. applications in radio and television receivers; it is especially recommended for f.m. tuners, low noise a.m. mixer-oscillators with high source impedance and i.f. amplifiers in a.m./f.m. receivers where a high current gain is of importance.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max. 30 V
Collector-emitter voltage (open base)	V_{CEO}	max. 20 V
Collector current (d.c.)	I_C	max. 30 mA
Total power dissipation up to $T_{amb} = 25^\circ C$	P_{tot}	max. 220 mW
Junction temperature	T_j	max. 125 °C
D.C. current gain at $T_j = 25^\circ C$ $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$	h_{FE}	typ. 115
Transition frequency $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$	f_T	typ. 260 MHz
Noise figure at $f = 100 \text{ MHz}$ $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}; G_S = 10 \text{ m}\Omega^{-1}$	F	typ. 4 dB
Conversion noise figure at $f = 1 \text{ MHz}$ $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}; G_S = 1.2 \text{ m}\Omega^{-1}$	F_c	typ. 2 dB

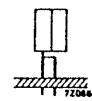
MECHANICAL DATA

Dimensions in mm

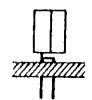


MOUNTING INSTRUCTIONS

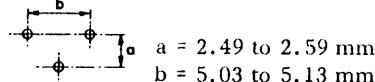
1. Thickness of printed board: max. 1.1 mm
Hole diameter 0.77 to 0.83 mm



2. Thickness of printed board: max. 1.7 mm
Hole diameter 1.25 to 1.35 mm



Bore plan



NOTE

For iron soldering or for dip soldering, the iron temperature or solder temperature may go up to 300 °C for a maximum of 3 seconds, with the transistor lock-fitted on printed boards in either of the possible mounting positions.

RATINGS (Limiting values)¹⁾

Voltages

Collector-base voltage (open emitter) V_{CBO} max. 30 V

Collector-emitter voltage (open base)
(See also page 4) V_{CEO} max. 20 V

Emitter-base voltage (open collector) V_{EBO} max. 5 V

Currents

Collector current (d.c.) I_C max. 30 mA

Collector current (peak value) I_{CM} max. 30 mA

Power dissipation

Total power dissipation up to $T_{amb} = 25^\circ\text{C}$ P_{tot} max. 220 mW

Temperatures

Storage temperature T_{stg} -65 to +125 °C

Junction temperature T_j max. 125 °C

THERMAL RESISTANCE

From junction to ambient in free air $R_{th j-a} = 0.45^\circ\text{C}/\text{mW}$

¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS

$T_J = 25^\circ\text{C}$

Base-emitter voltage¹⁾

$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$

V_{BE} 0.65 to 0.74 V

Base current

$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$

I_B 4.5 to 15 μA
typ. 8.7 μA

Feedback capacitance at $f = 0.45 \text{ MHz}$

$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$

$-C_{re}$ typ. 0.95 pF

Transition frequency

$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$

f_T typ. 260 MHz

Noise figure

$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$

F typ. 1.5 dB

$G_S = 2 \text{ m}\Omega^{-1}; f = 0.2 \text{ MHz}$

F typ. 1.2 dB

$G_S = 1.5 \text{ m}\Omega^{-1}; f = 1.0 \text{ MHz}$

F typ. 4 dB

Conversion noise figure

$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$

F_c typ. 3 dB

$G_S = 0.6 \text{ m}\Omega^{-1}; f = 0.2 \text{ MHz}$

F_c typ. 2 dB

 y parameters at $f = 100 \text{ MHz}$ (common base)

$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ (lead length = 3 mm)

g_{ib} typ. $36 \text{ m}\Omega^{-1}$

$-b_{ib}$ typ. $3 \text{ m}\Omega^{-1}$

Feedback admittance

$|y_{rb}|$ typ. $450 \mu\Omega^{-1}$

Phase angle of feedback admittance

φ_{rb} typ. 272°

Transfer admittance

$|y_{fb}|$ typ. $33 \text{ m}\Omega^{-1}$

Phase angle of transfer admittance

φ_{fb} typ. 146°

Output conductance

g_{ob} typ. $22 \mu\Omega^{-1}$

Output susceptance

b_{ob} typ. $1.1 \text{ m}\Omega^{-1}$

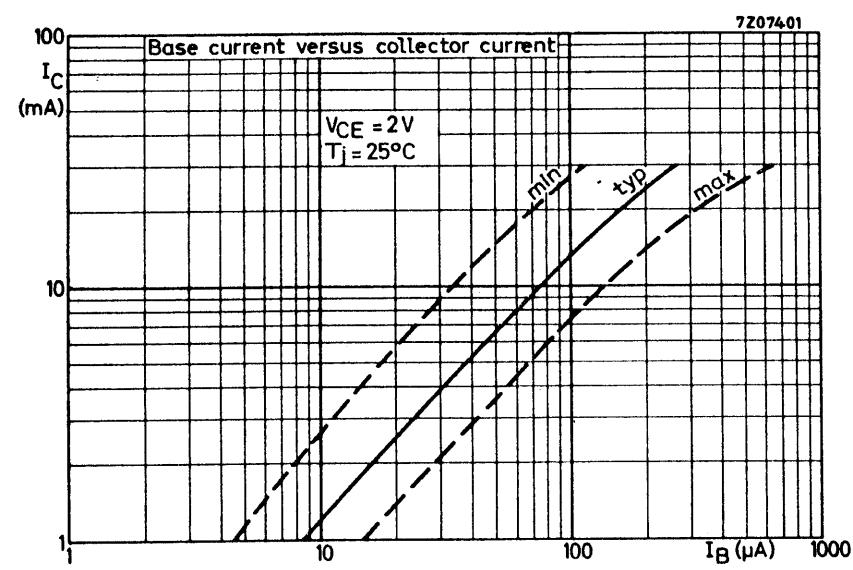
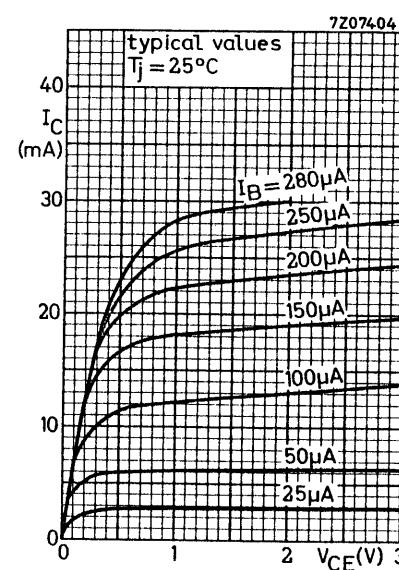
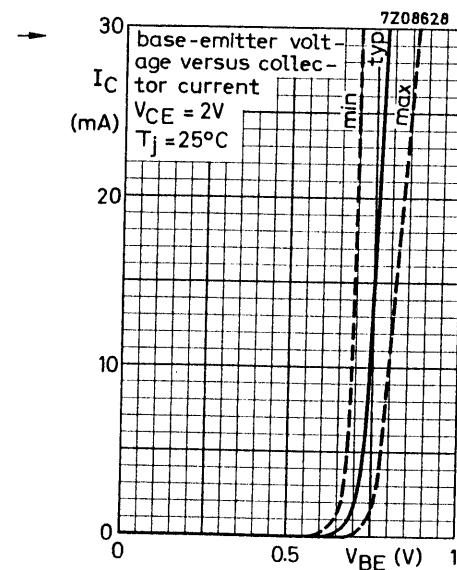
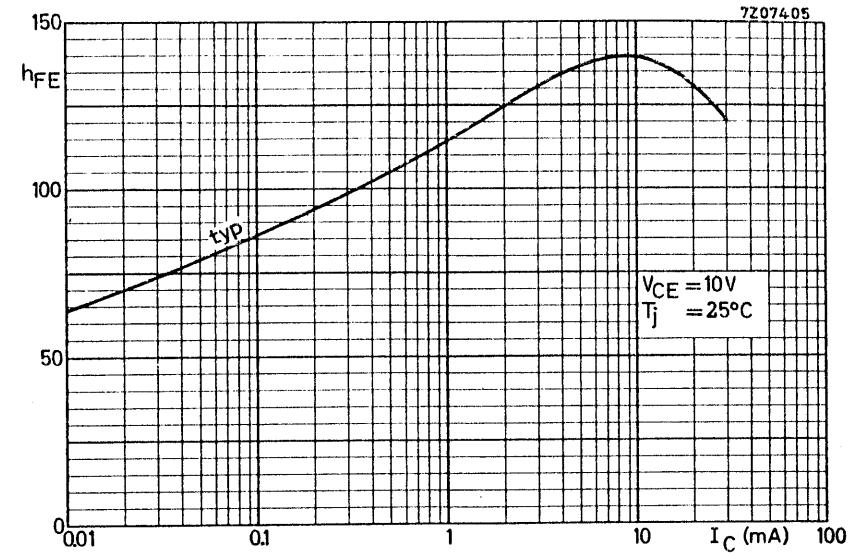
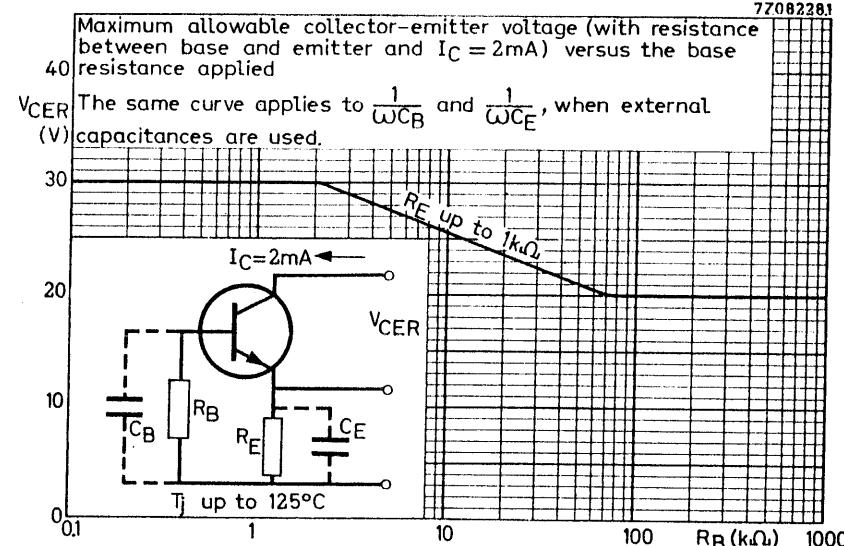
 y parameters (common emitter)

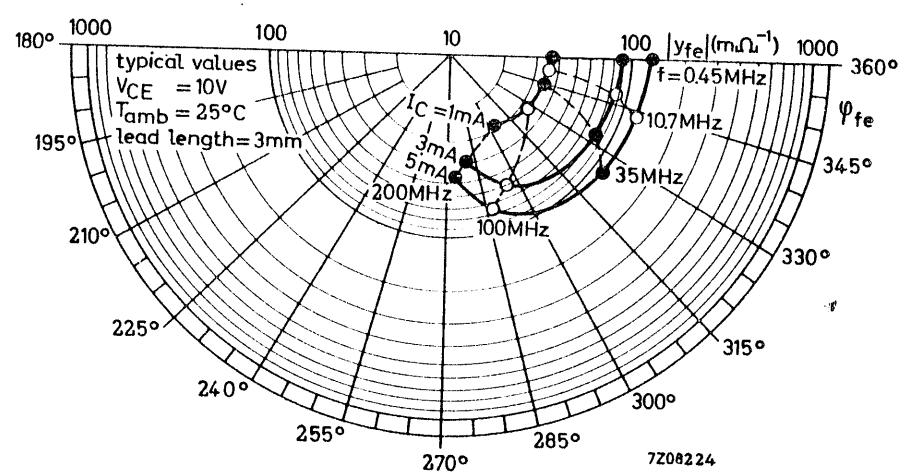
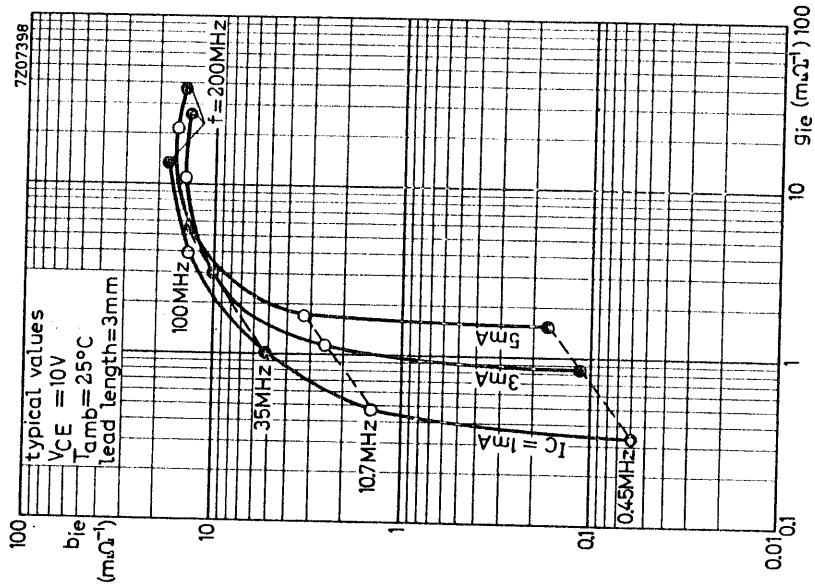
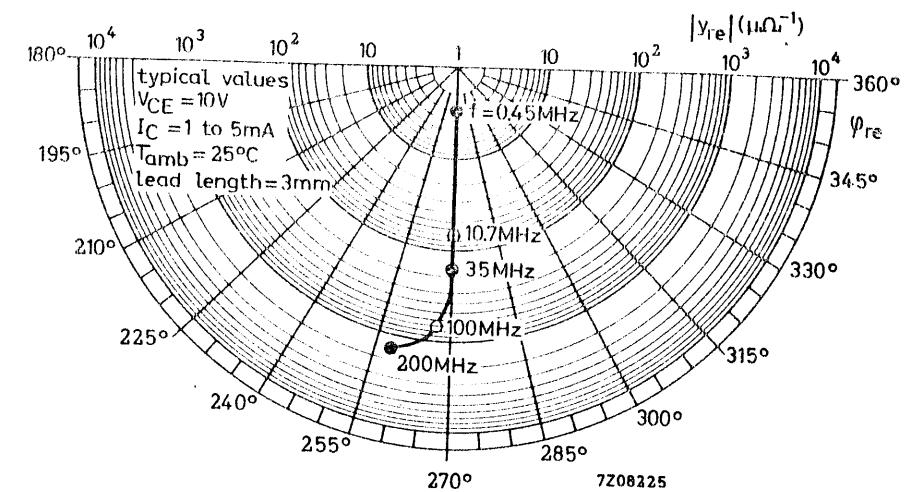
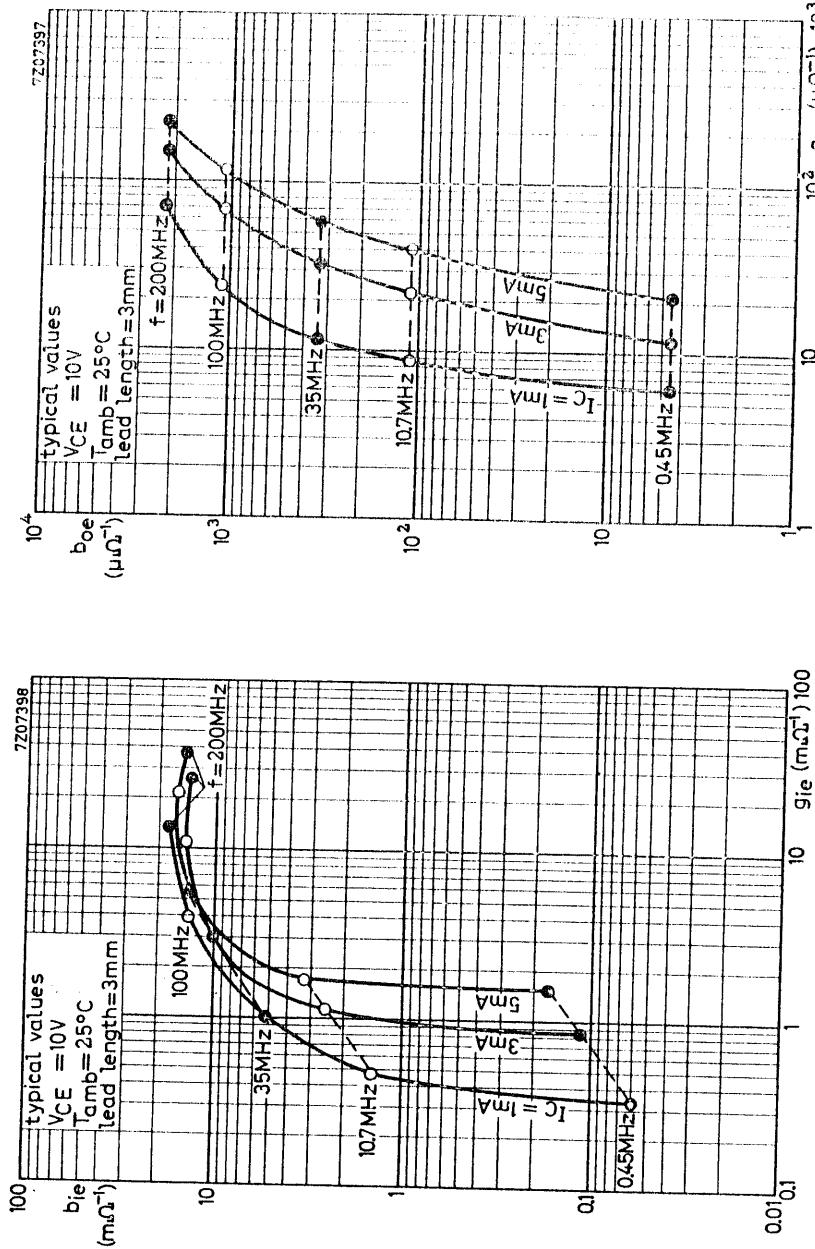
$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ (lead length = 3 mm)	$f = 10.7 \text{ MHz}$	$f = 0.45 \text{ MHz}$
--	------------------------	------------------------

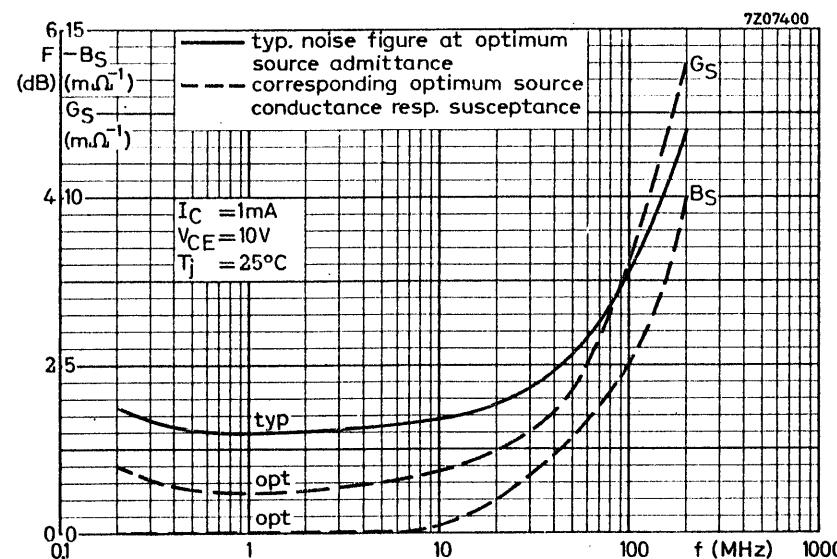
Input conductance	$g_{ie} < 0.64$	$0.54 \text{ m}\Omega^{-1}$
-------------------	-----------------	-----------------------------

Output conductance	$g_{oe} < 13.5$	$11.5 \mu\Omega^{-1}$
--------------------	-----------------	-----------------------

¹⁾ V_{BE} decreases by about 1.7 mV/°C with increasing temperature.







SILICON PLANAR EPITAXIAL TRANSISTOR

N-P-N transistor in a plastic envelope with stiff self-locking pins suitable for use with standard printed boards.

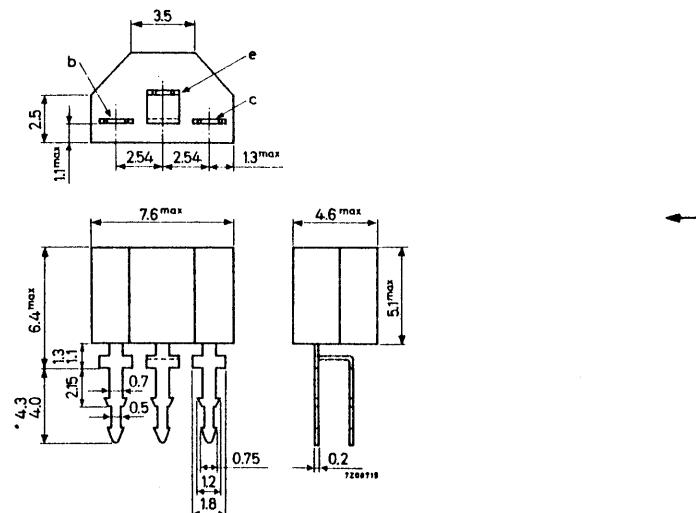
The BF195 is intended for h.f. applications in radio and television receivers; it is especially recommended for f.m. tuners, i.f. amplifiers in a.m./f.m. receivers where a low transistor output conductance is of importance, a.m. input stages of car radios where a low noise figure at low source impedance is required.

QUICK REFERENCE DATA

Collector-base voltage (open emitter)	V_{CBO}	max. 30 V
Collector-emitter voltage (open base)	V_{CEO}	max. 20 V
Collector current (d.c.)	I_C	max. 30 mA
Total power dissipation up to $T_{amb} = 25^\circ\text{C}$	P_{tot}	max. 220 mW
Junction temperature	T_j	max. 125 °C
D.C. current gain at $T_j = 25^\circ\text{C}$	h_{FE}	typ. 67
$I_C = 1\text{mA}; V_{CE} = 10\text{V}$	f_T	typ. 200 MHz
Transition frequency		
$I_C = 1\text{mA}; V_{CE} = 10\text{V}$	F	typ. 3.5 dB
Noise figure		
$I_C = 1\text{mA}; V_{CE} = 10\text{V}$	F	typ. 4 dB
$G_S = 20\text{m}\Omega^{-1}; f = 1\text{MHz}$		
$G_S = 10\text{m}\Omega^{-1}; f = 100\text{MHz}$		

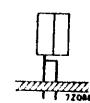
MECHANICAL DATA

Dimensions in mm

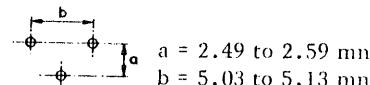


MOUNTING INSTRUCTIONS

1. Thickness of printed board: max. 1.1 mm
Hole diameter 0.77 to 0.83 mm



2. Thickness of printed board: max. 1.7 mm
Hole diameter 1.25 to 1.35 mm

**Bore plan****NOTE**

For iron soldering or for dip soldering, the iron temperature or solder temperature may go up to 300 °C for a maximum of 3 seconds, with the transistor lock-fitted on printed boards in either of the possible mounting positions.

RATINGS (Limiting values)¹⁾**Voltages**

Collector-base voltage (open emitter) V_{CBO} max. 30 V

Collector-emitter voltage (open base)
(See also page 4) V_{CEO} max. 20 V

Emitter-base voltage (open collector) V_{EBO} max. 5 V

Currents

Collector current (d.c.) I_C max. 30 mA

Collector current (peak value) I_{CM} max. 30 mA

Power dissipation

Total power dissipation up to $T_{amb} = 25^\circ\text{C}$ P_{tot} max. 220 mW

Temperatures

Storage temperature T_{stg} -65 to +125 °C

Junction temperature T_j max. 125 °C

THERMAL RESISTANCE

From junction to ambient in free air $R_{th j-a}$ = 0.45 °C/mW

¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS**Base-emitter voltage¹⁾**

$T_j = 25^\circ\text{C}$

V_{BE} 0.65 to 0.74 V

Base current

I_B typ. 8 to 28 μA
typ. 15 μA

Feedback capacitance at $f = 0.45 \text{ MHz}$

$-C_{re}$ typ. 0.95 pF

Transition frequency

f_T typ. 200 MHz

Noise figure

F typ. 3.5 dB

$G_S = 20 \text{ m}\Omega^{-1}; f = 1 \text{ MHz}$

F typ. 4 dB

$G_S = 10 \text{ m}\Omega^{-1}; f = 100 \text{ MHz}$

F typ. 2.5 dB

Conversion noise figure

$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$

F_c typ. 4 dB

$G_S = 1.2 \text{ m}\Omega^{-1}; f = 0.2 \text{ MHz}$

F_c typ. 2.5 dB

$G_S = 1.5 \text{ m}\Omega^{-1}; f = 1 \text{ MHz}$

y parameters at $f = 100 \text{ MHz}$ (common base)

$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ (lead length = 3 mm)

g_{ib} typ. $38 \text{ m}\Omega^{-1}$

$-b_{ib}$ typ. $1 \text{ m}\Omega^{-1}$

$|y_{rb}|$ typ. $440 \mu\Omega^{-1}$

φ_{rb} typ. 275°

$|y_{fb}|$ typ. $34 \text{ m}\Omega^{-1}$

φ_{fb} typ. 140°

g_{ob} typ. $12 \mu\Omega^{-1}$

b_{ob} typ. $1.1 \text{ m}\Omega^{-1}$

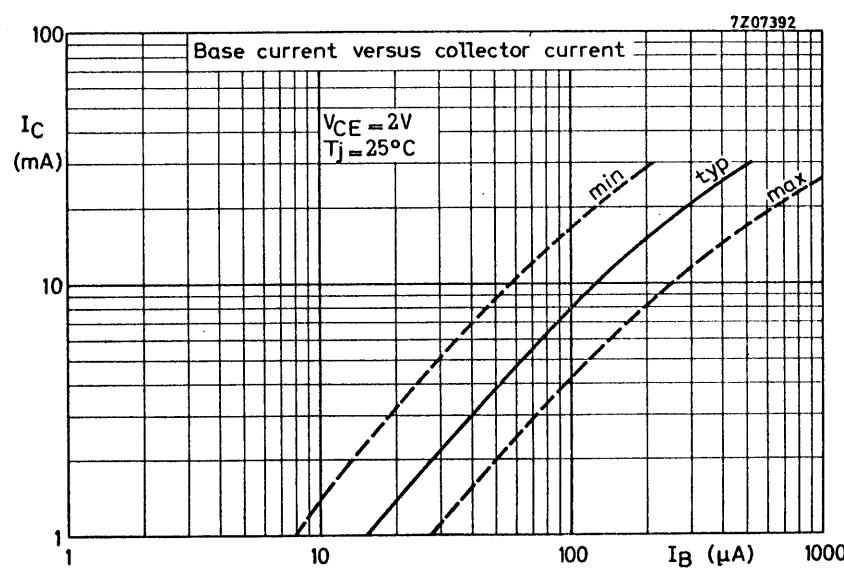
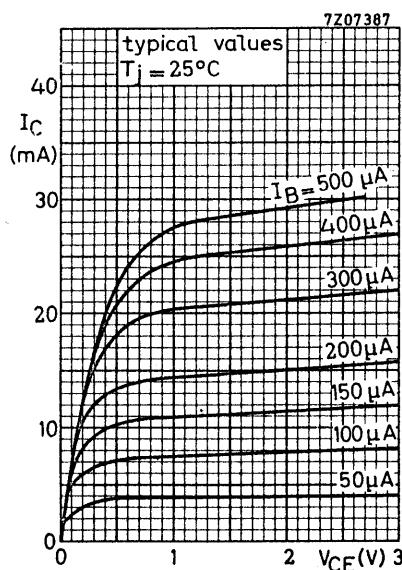
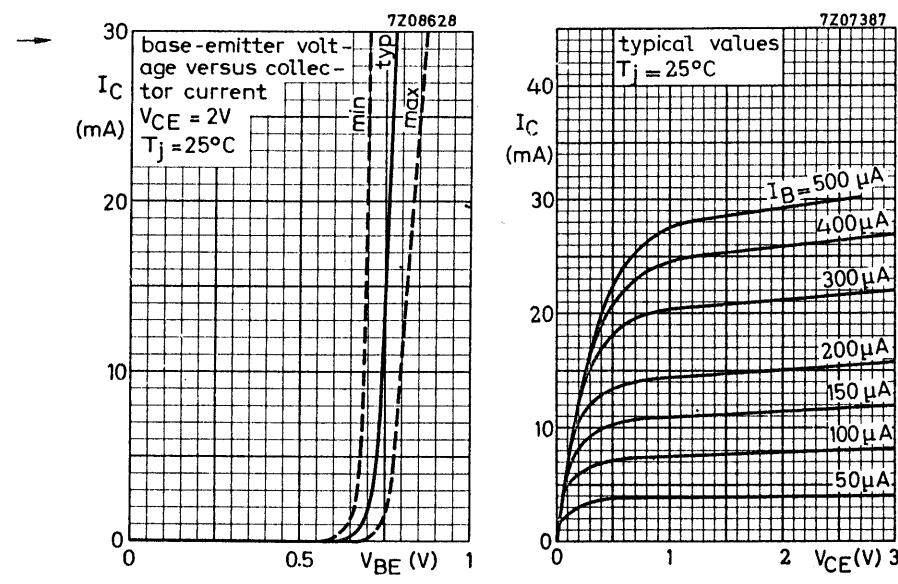
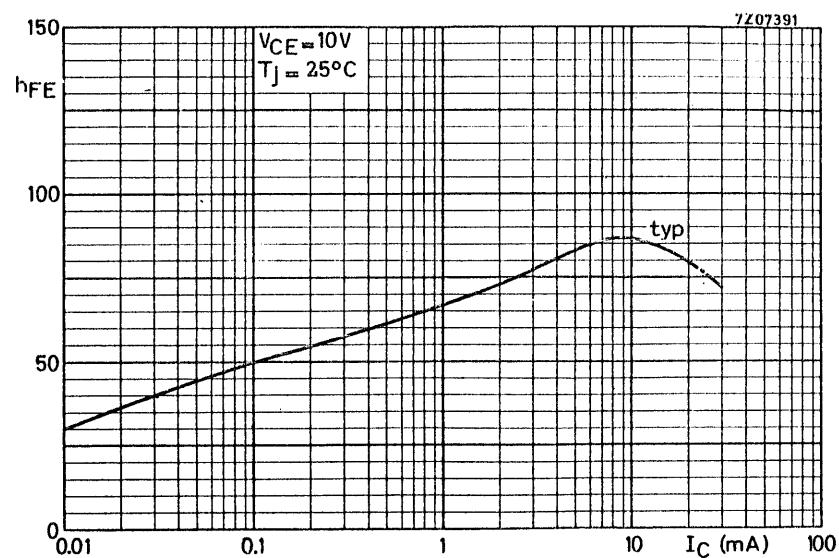
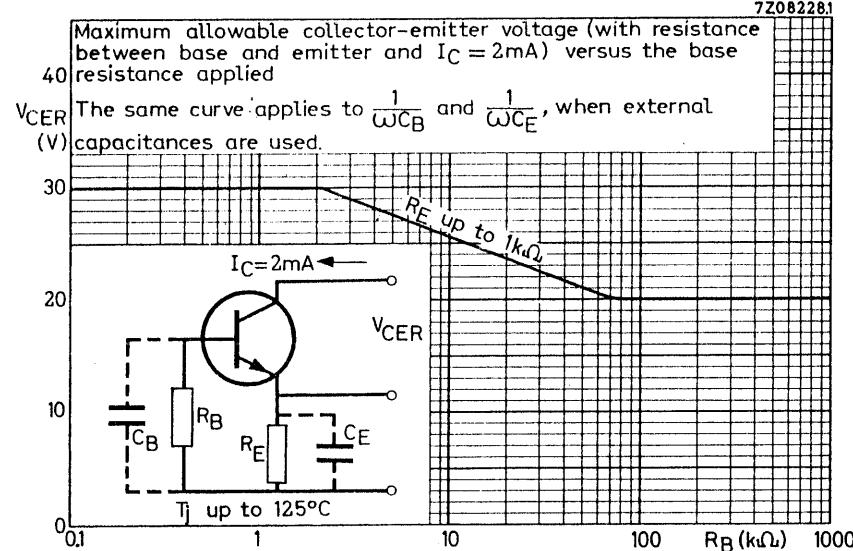
y parameters (common emitter)

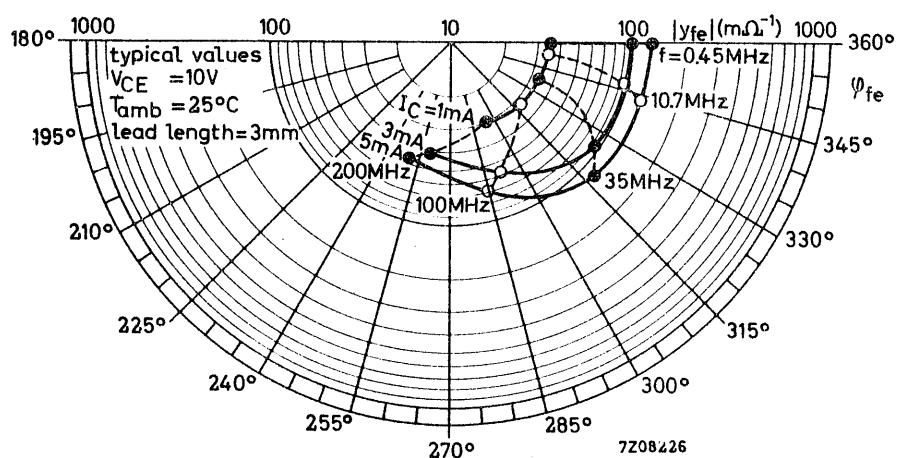
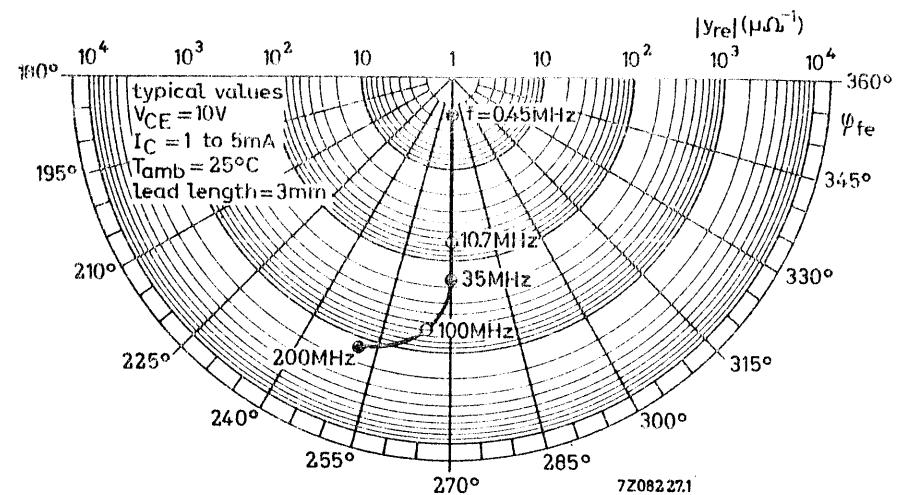
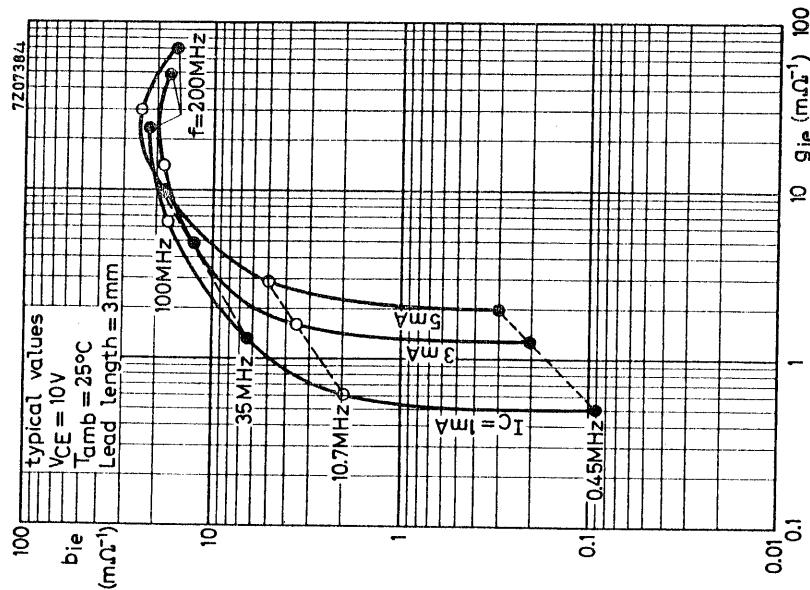
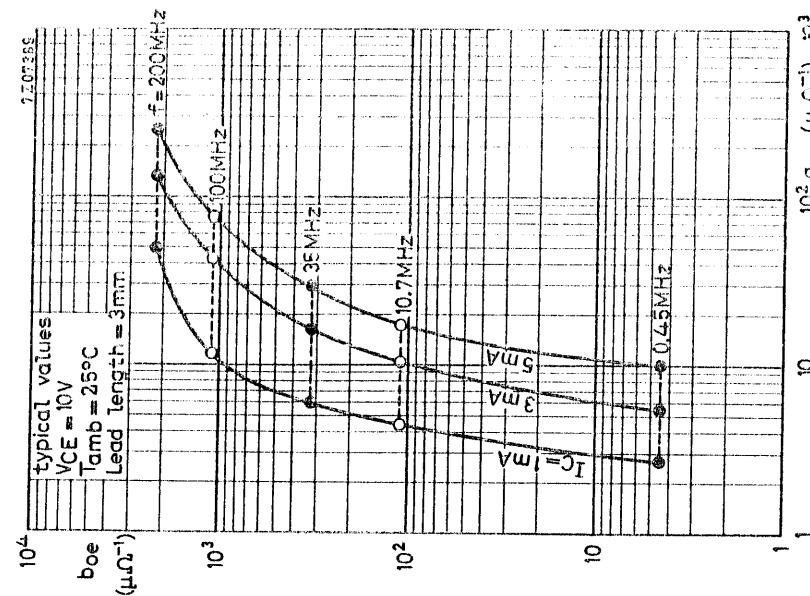
$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ (lead length = 3 mm) $f = 10.7 \text{ MHz}$ $f = 0.45 \text{ MHz}$

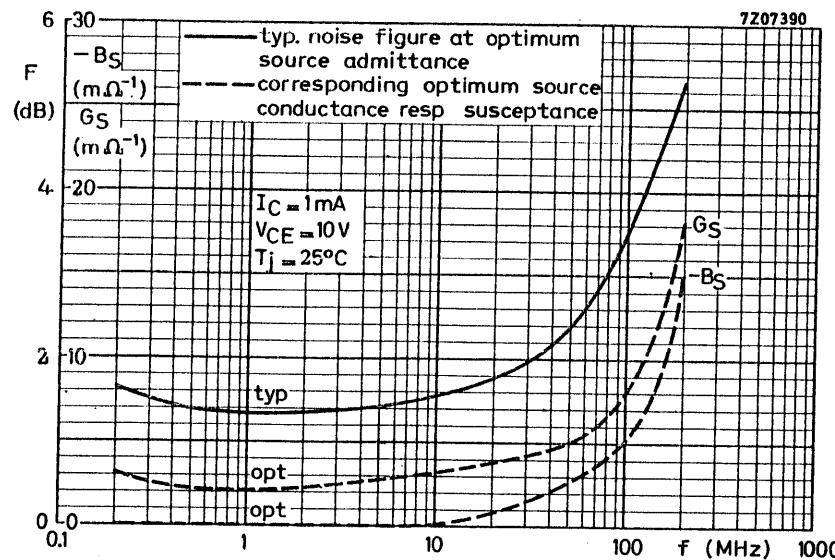
$g_{ie} < 0.96$ $0.86 \text{ m}\Omega^{-1}$

$g_{oe} < 9.5$ $7.0 \mu\Omega^{-1}$

¹⁾ V_{BE} decreases by about 1.7 mV/°C with increasing temperature.







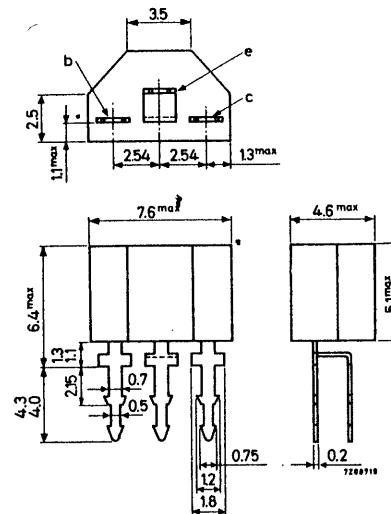
SILICON PLANAR TRANSISTOR

N-P-N transistor in a plastic envelope with stiff self-locking pins suitable for use with standard printed boards. The transistor has a very low feedback capacitance and is intended for use in the forward gain control stage of the television i.f. amplifier.

QUICK REFERENCE DATA	
Collector-base voltage (open emitter)	V_{CBO} max. 40 V
Collector-emitter voltage (open base)	V_{CEO} max. 30 V
Collector current (d.c.)	I_C max. 25 mA
Total power dissipation up to $T_{amb} = 25^\circ\text{C}$	P_{tot} max. 250 mW
Junction temperature	T_j max. 125 $^\circ\text{C}$
Transition frequency at $f = 100 \text{ MHz}$ $I_C = 4 \text{ mA}; V_{CE} = 10 \text{ V}$	f_T typ. 400 MHz
Feedback capacitance at $f = 10.7 \text{ MHz}$ $I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$	$-C_{re}$ typ. 200 fF
Max. unilateralised power gain $I_C = 4 \text{ mA}; V_{CE} = 10 \text{ V}; f = 35 \text{ MHz}$ $f = 45 \text{ MHz}$	G_{UM} typ. 42 dB G_{UM} typ. 39 dB
Gain control range.	ΔG_{tr} typ. 60 dB

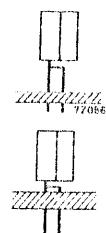
MECHANICAL DATA

Dimensions in mm

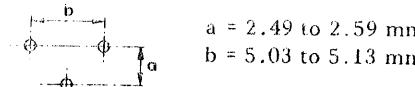


MOUNTING INSTRUCTIONS

1. Thickness of printed board: max. 1.1 mm
Hole diameter 0.77 to 0.83 mm



2. Thickness of printed board: max. 1.7 mm
Hole diameter 1.25 to 1.35 mm

floor plan**RATINGS (Limiting values)¹⁾****Voltages**

Collector-base voltage (open emitter)	V_{CBO}	max.	40 V
Collector-emitter voltage (open base)	V_{CEO}	max.	30 V ²⁾
Emitter-base voltage (open collector)	V_{EBO}	max.	4 V

Currents

Collector current (d.c.)	I_C	max.	25 mA
Collector current (peak value)	I_{CM}	max.	25 mA

Power dissipation

Total power dissipation up to $T_{amb} = 25^\circ\text{C}$	P_{tot}	max.	250 mW
--	-----------	------	--------

Temperatures

Storage temperature	T_{stg}	-65 to +125	$^\circ\text{C}$
Junction temperature	T_j	max.	125 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th j-a}$	=	0.4 $^\circ\text{C}/\text{mW}$
--------------------------------------	--------------	---	--------------------------------

¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

²⁾ See also page 6.

CHARACTERISTICS

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

Base current at about 50 dB gain control

$$I_C = 6 \text{ mA}; V_{CE} = 2 \text{ V}$$

$$I_B \leq 270 \mu\text{A}$$

$$I_C = 15 \text{ mA}; V_{CE} = 5 \text{ V}$$

$$I_B \leq 1.5 \text{ mA}$$

Base current

$$I_C = 4 \text{ mA}; V_{CE} = 10 \text{ V}$$

$$I_B \text{ typ. } < 150 \mu\text{A}$$

Base-emitter voltage¹⁾

$$I_C = 4 \text{ mA}; V_{BE} = 10 \text{ V}$$

$$V_{BE} \text{ typ. } < 150 \text{ mV}$$

$$V_{BE} \text{ typ. } < 140 \text{ mV}$$

Feedback capacitance at $f = 10.7 \text{ MHz}$

$$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$$

$$-C_{re} \text{ typ. } 100 \text{ fF}$$

Transition frequency at $f = 100 \text{ MHz}$

$$I_C = 4 \text{ mA}; V_{CE} = 10 \text{ V}$$

$$f_T \text{ typ. } 40 \text{ MHz}$$

Noise figure

$$I_C = 4 \text{ mA}; V_{CE} = 10 \text{ V}$$

$$G_S = 10 \text{ m}\Omega^{-1}; f = 35 \text{ MHz}; B_S = 0$$

$$F \text{ typ. } 3 \text{ dB}$$

y parameters (common emitter)

$$I_C = 4 \text{ mA}; V_{CE} = 10 \text{ V} \text{ (mounted according to instruction 2, see page 2)}$$

	$f = 35$	45 MHz
Input conductance	g_{ie} typ. 3.2	$4.8 \text{ m}\Omega^{-1}$
Input capacitance	C_{ie} typ. 37	35 pF
Feedback admittance	$ y_{re} $ typ. 47	$60 \mu\Omega^{-1}$
Phase angle of feedback admittance	φ_{re} typ. 268°	268°
Transfer admittance	$ y_{fe} $ typ. 105	$100 \text{ m}\Omega^{-1}$
Phase angle of transfer admittance	φ_{fe} typ. 340°	340°
Output conductance	g_{oe} typ. 50	$60 \text{ m}\Omega^{-1}$
Output capacitance	C_{oe} typ. 1.3	1.3 pF

Maximum unilateralised power gain

$$G_{UM} \text{ (in dB)} = 10 \log \frac{|y_{fe}|^2}{4 g_{ie} g_{oe}}$$

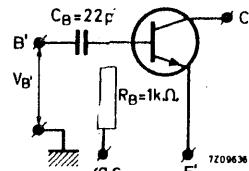
$$I_C = 4 \text{ mA}; V_{CE} = 10 \text{ V}$$

$$G_{UM} \text{ typ. } 42 \text{ dB}$$

¹⁾ V_{BE} decreases by about 1.7 mV/ $^\circ\text{C}$ with increasing temperature.

Equivalent ga'n control transistor

To ensure a almost constant input admittance and an output conductance that varies little with gain control, we recommend that where a BF196 is used in a gain controlled i.f. stage, a series base capacitor of 22 pF and a bias resistor of 1 k Ω be used.

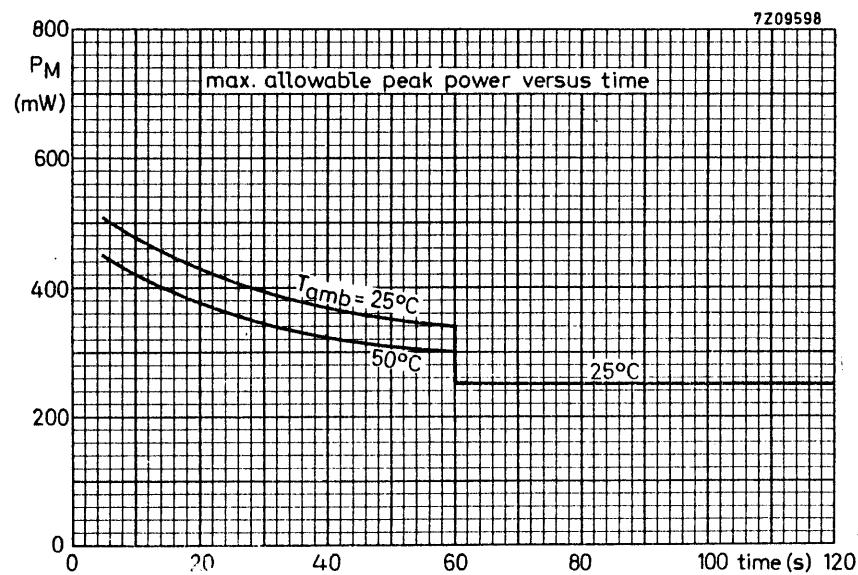
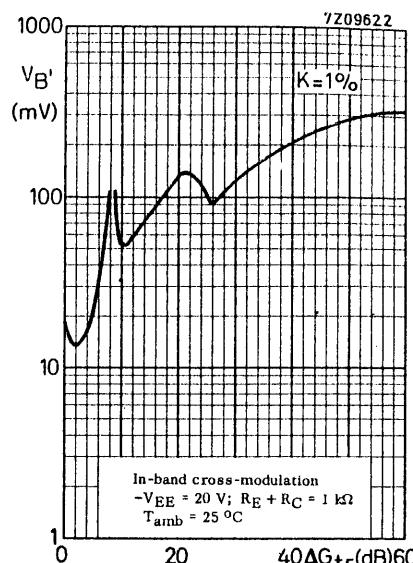
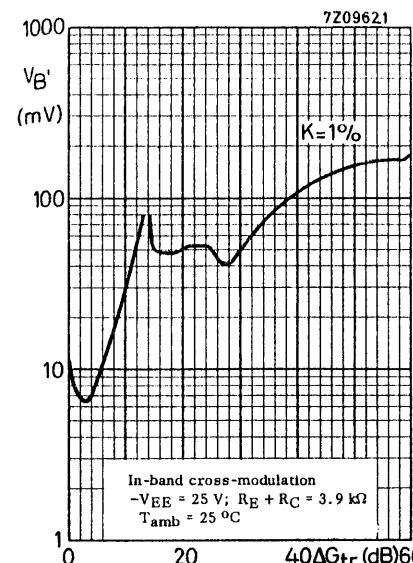
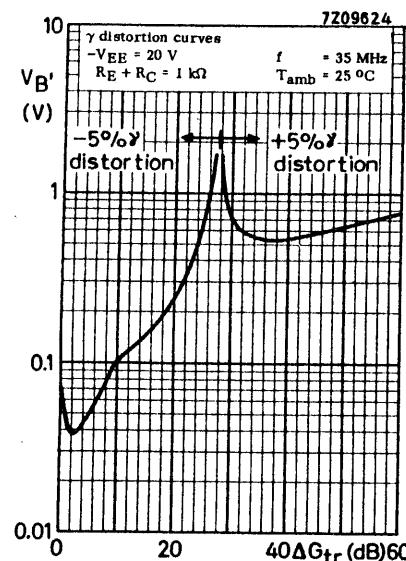
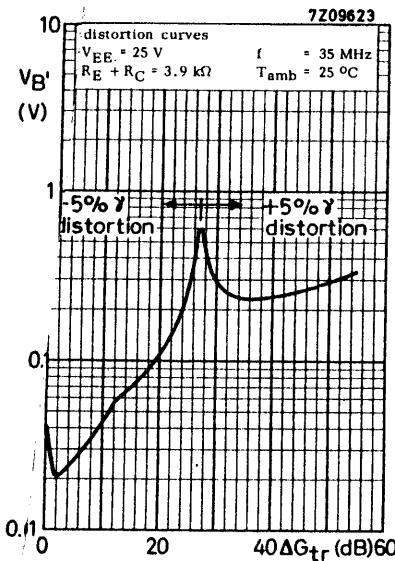


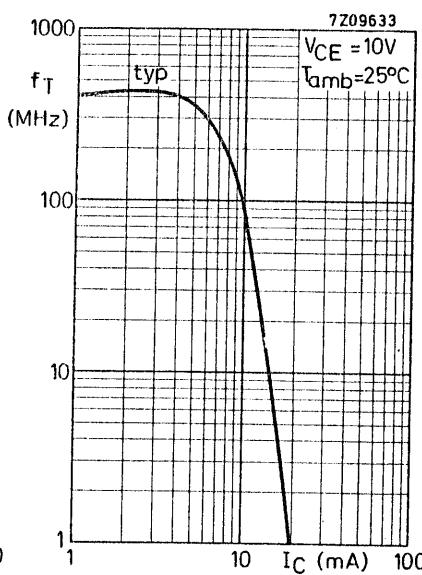
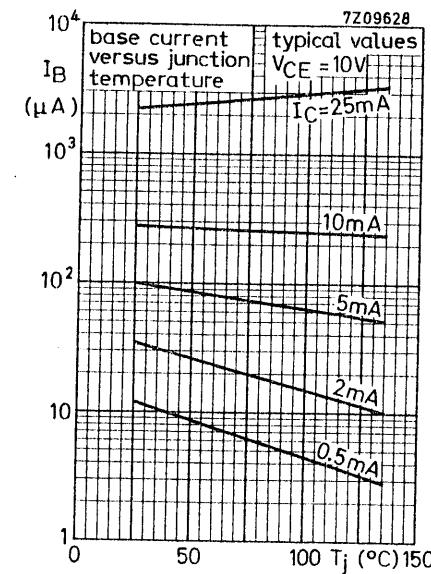
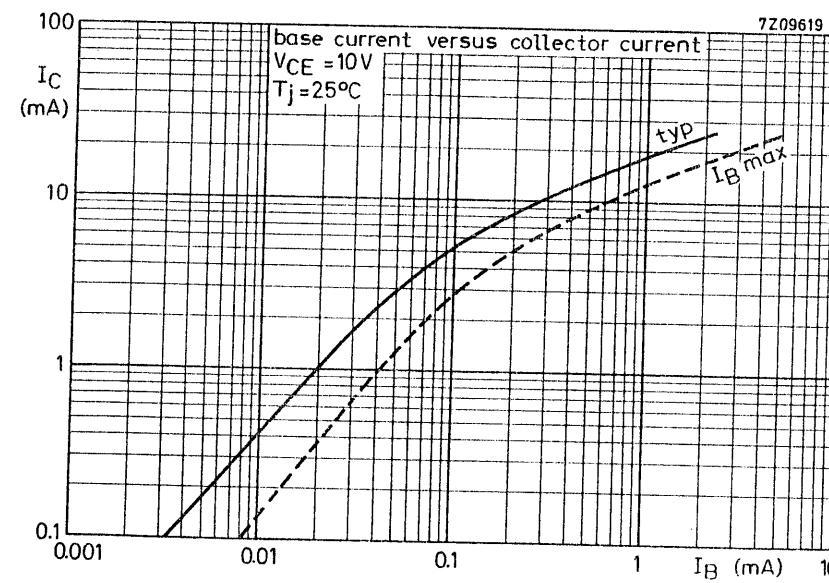
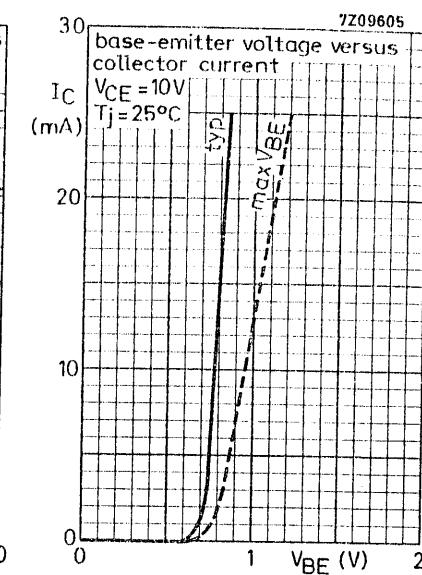
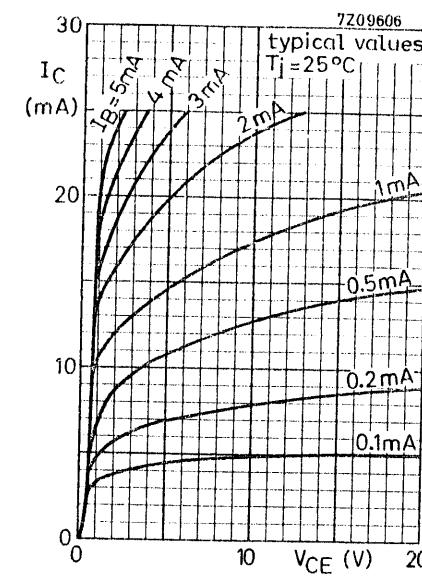
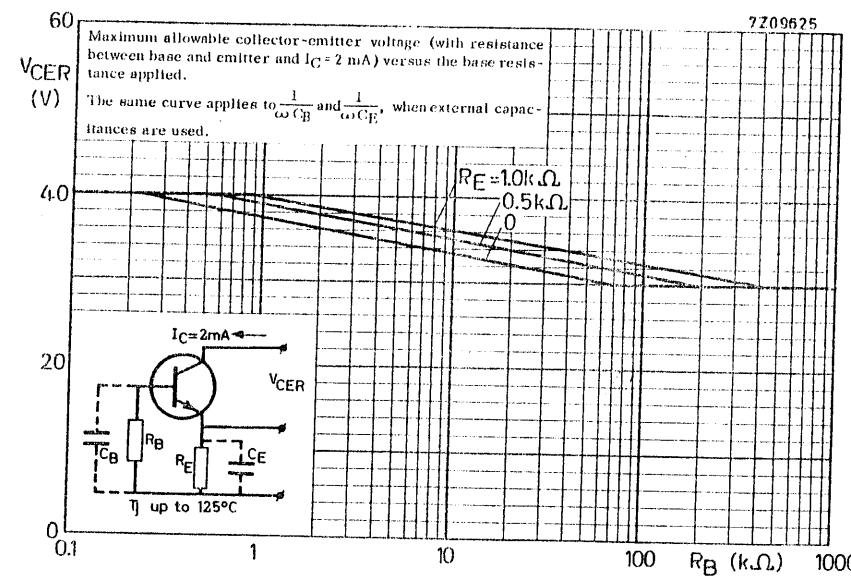
The transistor with these additional components is effectively an "equivalent transistor" for gain control purposes, the signal handling capability of which may be expressed in terms of voltage. (Without these components the varying input admittance means that the signal handling capability can only be expressed in terms of power).

The signal handling capability of the equivalent transistor as a function of ΔG_{tr} (the reduction in transducer gain with gain control) will be found on pages 4 and 5.

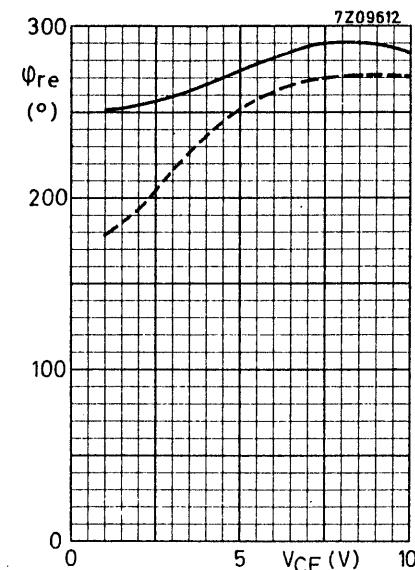
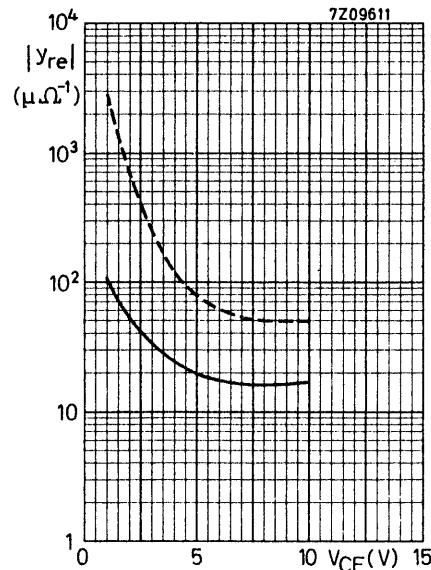
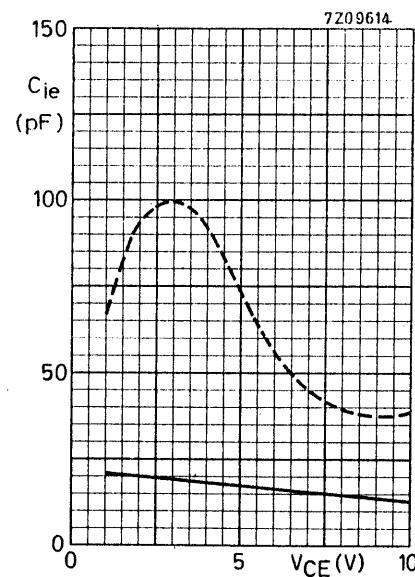
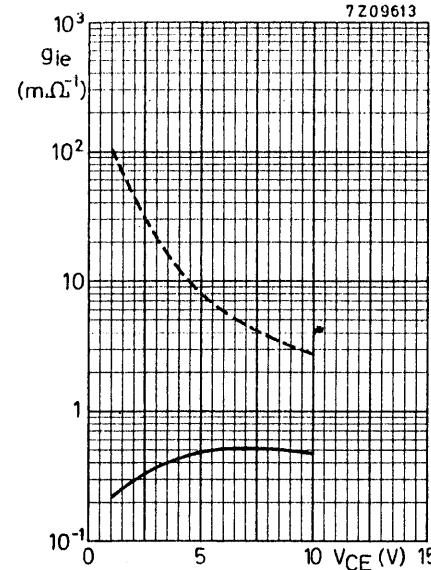
- a. Voltage versus ΔG_{tr} curves for a γ distortion of 5% are below.
- b. Voltage versus ΔG_{tr} curves for an in-band cross modulation factor of 1% are on page 5.

Graphs of the y-parameters are on pages 8 to 11.

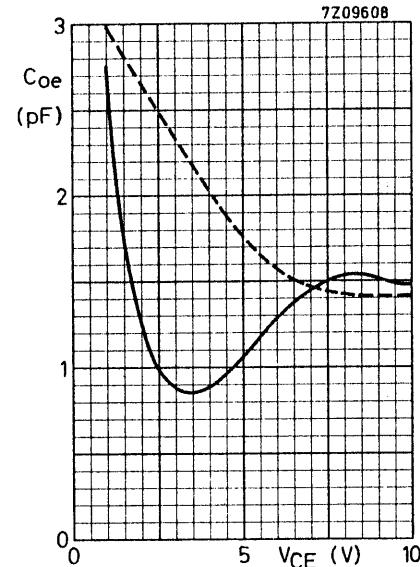
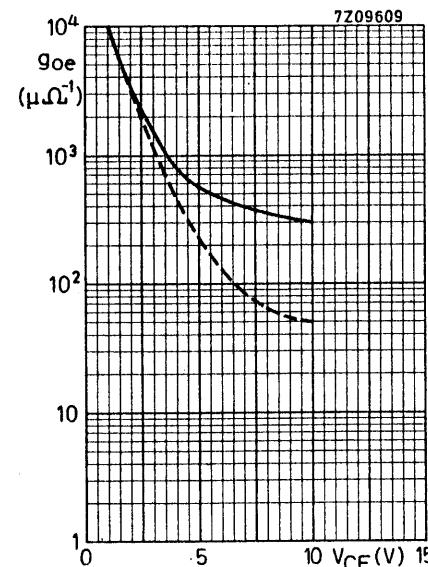
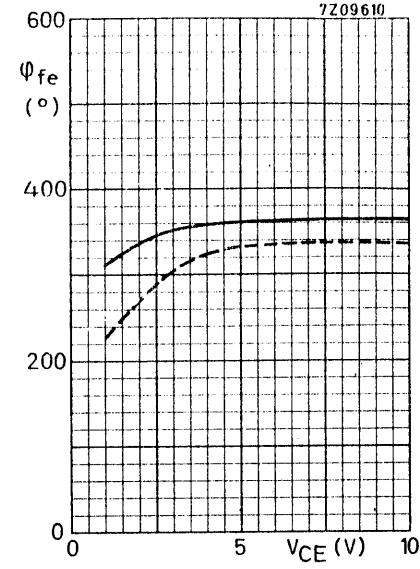
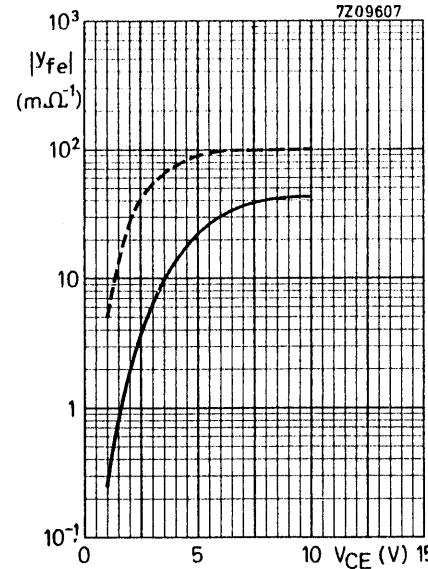




Voltage control; $-V_{EE} = 25$ V; $R_E + R_C = 3.9$ k Ω ; $f = 35$ MHz

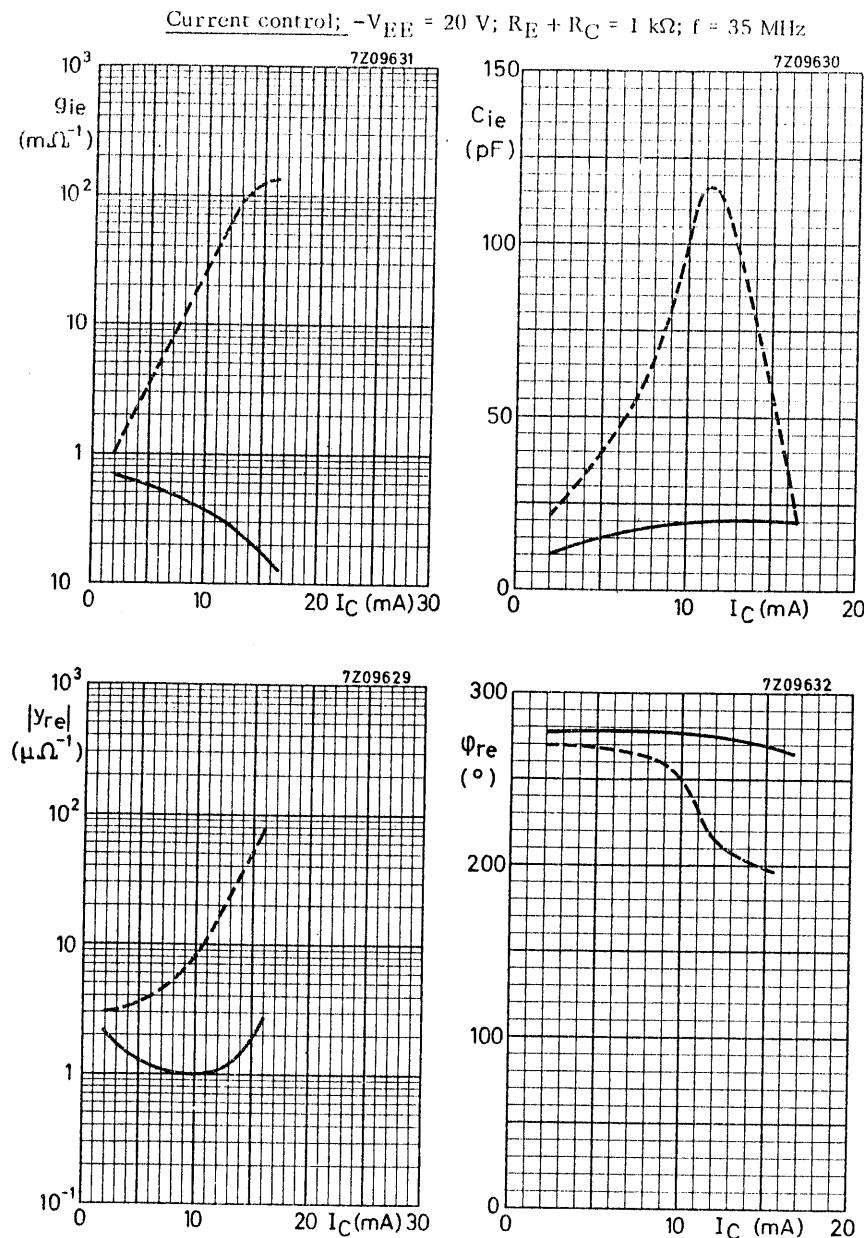


Voltage control; $-V_{EE} = 25$ V; $R_E + R_C = 3.9$ k Ω ; $f = 35$ MHz

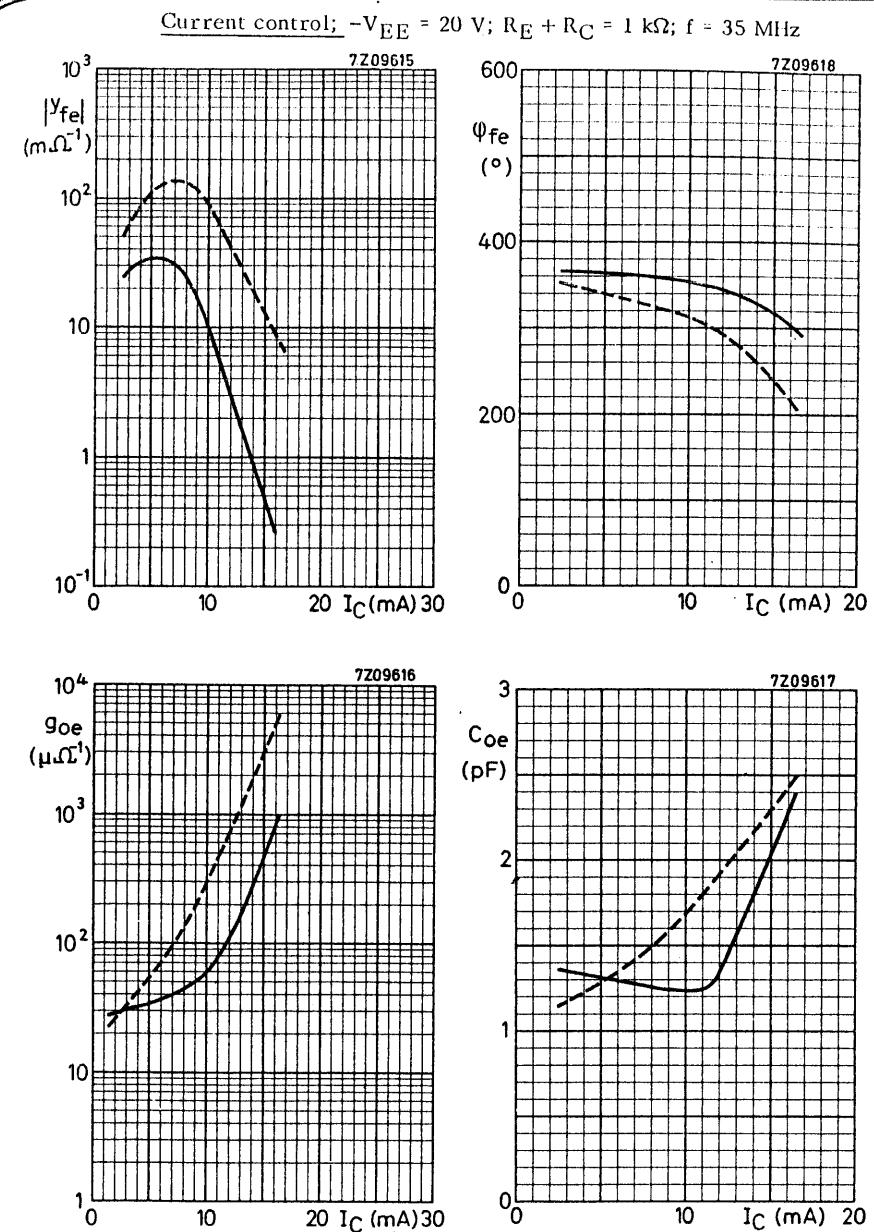


y-parameters of the equivalent gain control transistor, including base capacitor and base resistor as shown on page 4 (dashed curves apply to the transistor only).

y-parameters of the equivalent gain control transistor, including base capacitor and base resistor as shown on page 4 (dashed curves apply to the transistor only).



y-parameters of the equivalent gain control transistor, including base capacitor and base resistor as shown on page 4 (dashed curves apply to the transistor only).

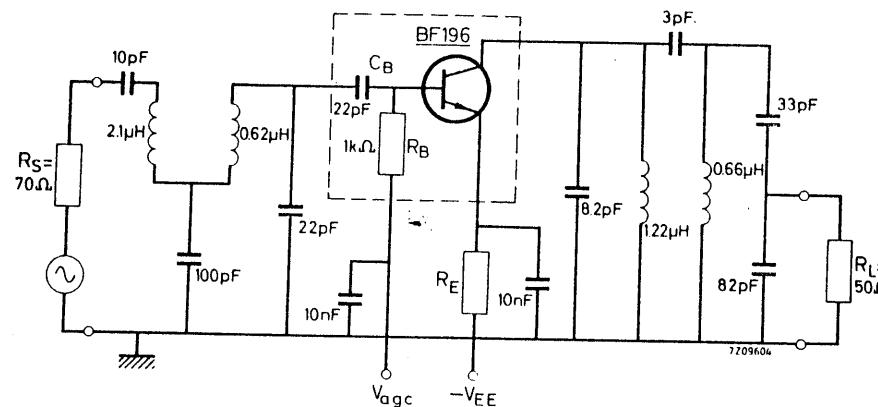


y-parameters of the equivalent gain control transistor, including base capacitor and base resistor as shown on page 4 (dashed curves apply to the transistor only).

APPLICATION INFORMATION

First stage of an i.f. amplifier

Basic circuit with voltage gain control: $R_E + R_C = 3.9 \text{ k}\Omega$; $-V_{EE} = 25 \text{ V}$
 current gain control: $R_E + R_C = 1 \text{ k}\Omega$; $-V_{EE} = 20 \text{ V}$



Transducer gain

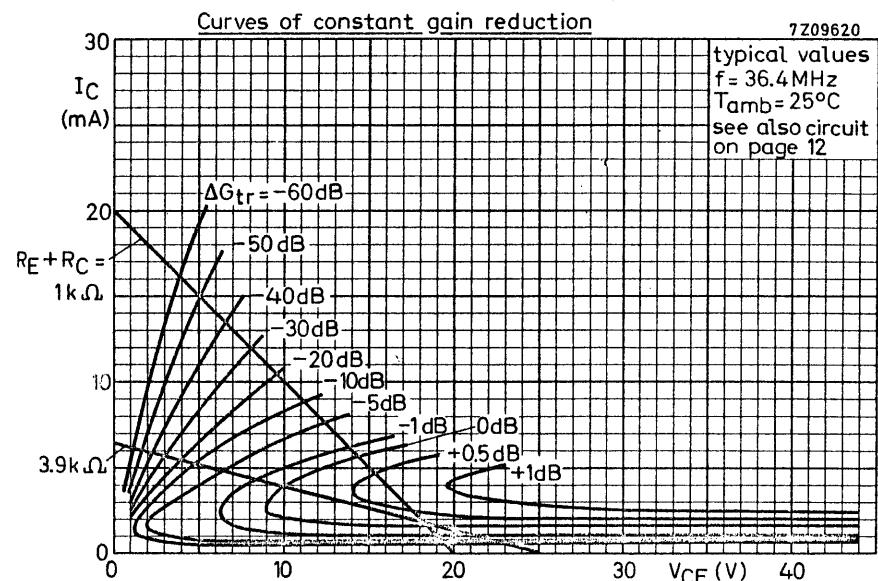
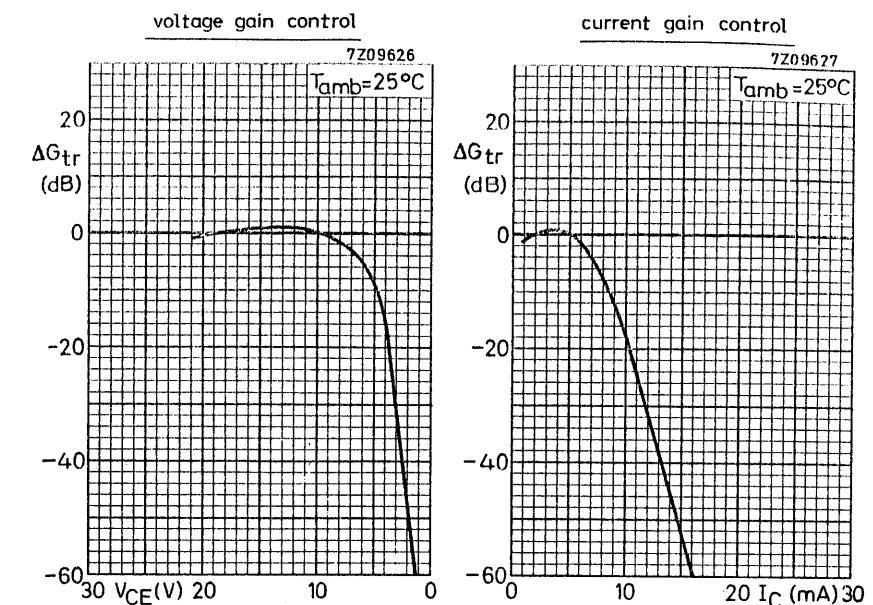
$$G_{tr} (\text{in dB}) = 10 \log \frac{\text{output power in load } R_L}{\text{available power from source } R_S}$$

$f = 36.4 \text{ MHz}; I_C = 4 \text{ mA}; R_E + R_C = 3.9 \text{ k}\Omega; -V_{EE} = 25 \text{ V} \quad G_{tr} \text{ typ. } 25.5 \text{ dB}$

Gain control range (see also upper graphs next page)

$\Delta G_{tr} \text{ typ. } 60 \text{ dB}$

¹⁾ Application information bulletins are available on request.



SILICON PLANAR TRANSISTOR

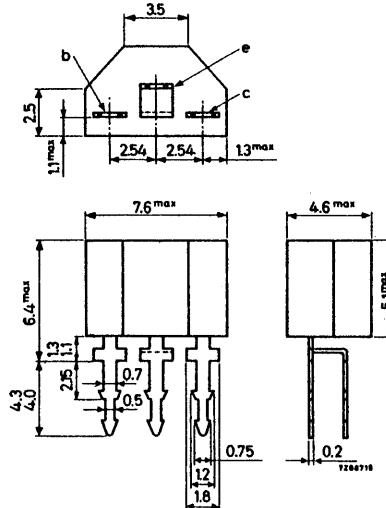
N-P-N transistor in a plastic envelope with stiff self-locking pins suitable for use with standard printed boards.

The BF197 has a very low feedback capacitance and is intended for use in the output stage of a television video i.f. amplifier.

QUICK REFERENCE DATA			
Collector-base voltage (open emitter)	V _{CBO}	max.	40 V
Collector-emitter voltage (open base)	V _{CEO}	max.	25 V
Collector current (d.c.)	I _C	max.	25 mA
Total power dissipation up to T _{amb} = 25 °C	P _{tot}	max.	250 mW
Junction temperature	T _j	max.	125 °C
Transition frequency at f = 100 MHz I _C = 5 mA; V _{CE} = 10 V	f _T	typ.	550 MHz
Feedback capacitance at f = 10.7 MHz I _C = 1 mA; V _{CE} = 10 V	-C _{re}	typ.	300 fF
Max. unilateralised power gain I _C = 7 mA; V _{CE} = 10 V; f = 35 MHz f = 45 MHz	GUM	typ.	43 dB
	GUM	typ.	41 dB
Video detector output voltage	V _O	typ.	7.7 V

MECHANICAL DATA

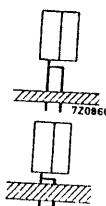
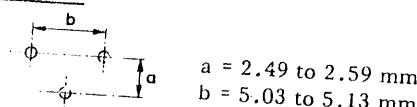
Dimensions in mm



MOUNTING INSTRUCTIONS

1. Thickness of printed board: max. 1.1 mm
Hole diameter 0.77 to 0.83 mm

2. Thickness of printed board: max. 1.7 mm
Hole diameter 1.25 to 1.35 mm

Bore plan**RATINGS (Limiting values) 1)**Voltages

Collector-base voltage (open emitter)

V_{CBO} max. 40 V

Collector-emitter voltage (open base)

V_{CEO} max. 25 V 2)

Emitter-base voltage (open collector)

V_{EBO} max. 4 VCurrents

Collector current (d.c.)

I_C max. 25 mA

Collector current (peak value)

I_{CM} max. 25 mAPower dissipationTotal power dissipation up to T_{amb} = 25 °CP_{tot} max. 250 mWTemperatures

Storage temperature

T_{stg} -65 to +125 °C

Junction temperature

T_j max. 125 °C**THERMAL RESISTANCE**

From junction to ambient in free air

R_{th j-a} = 0.4 °C/mW**CHARACTERISTICS**Base currentI_C = 7 mA; V_{CE} = 10 VI_B typ. < 60 μA
< 185 μABase-emitter voltage 1)I_C = 7 mA; V_{CE} = 10 VV_{BE} typ. 750 mV
< 900 mVFeedback capacitance at f = 10.7 MHzI_C = 1 mA; V_{CE} = 10 V-C_{re} typ. 300 fFTransition frequency at f = 100 MHzI_C = 5 mA; V_{CE} = 10 Vf_T typ. 550 MHzy parameters (common emitter)I_C = 7 mA; V_{CE} = 10 V (mounted according to instruction 2, see page 2)

Input conductance

g_{ie} typ. 4.5 5.5 mΩ⁻¹

Input capacitance

C_{ie} typ. 45 45 pF

Feedback admittance

|y_{re}| typ. 67 86 μΩ⁻¹

Phase angle of feedback admittance

φ_{re} typ. 268° 268°

Transfer admittance

|y_{fe}| typ. 170 155 mΩ⁻¹

Phase angle of transfer admittance

φ_{fe} typ. 338° 335°

Output conductance

g_{oe} typ. 85 95 μΩ⁻¹

Output capacitance

C_{oe} typ. 1.8 1.8 pFMaximum unilateralised power gain

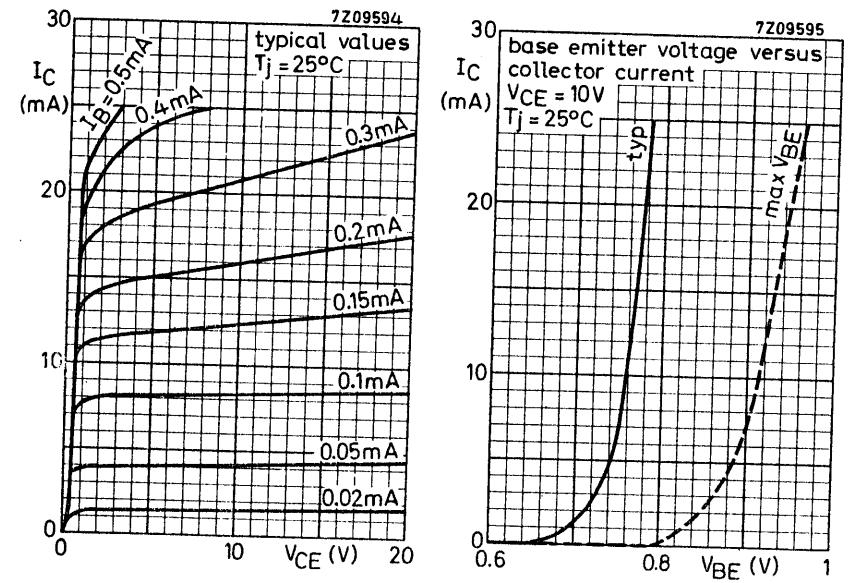
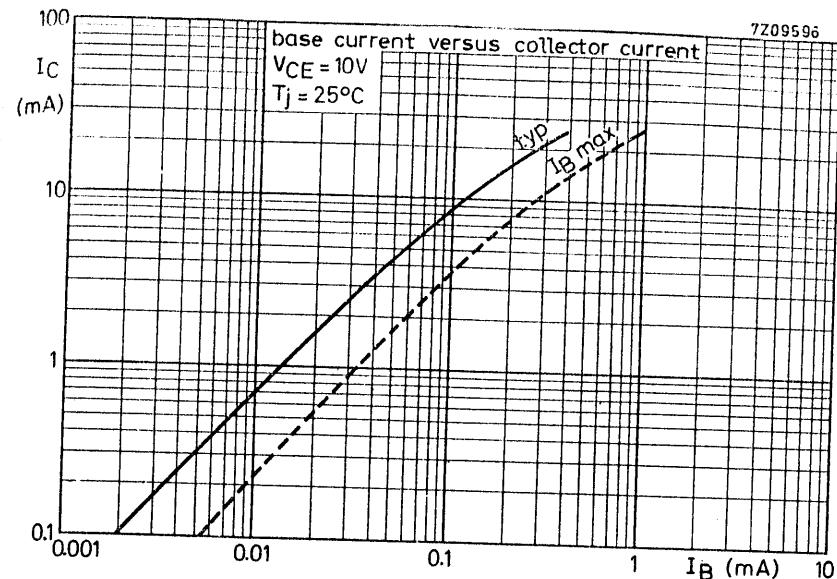
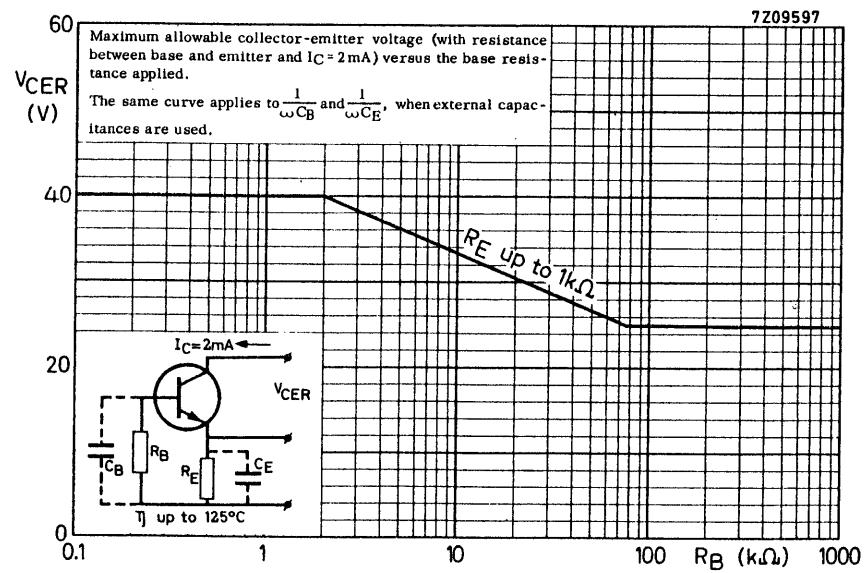
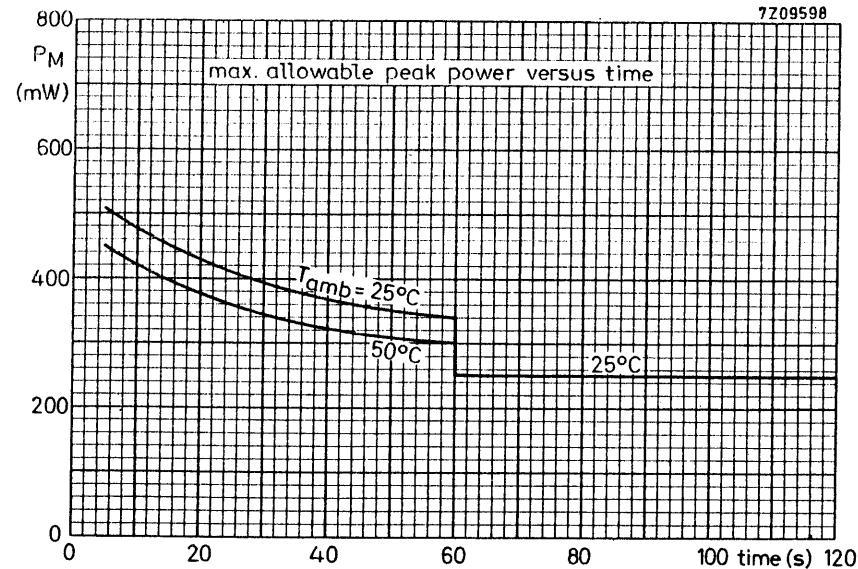
$$G_{UM} \text{ (in dB)} = 10 \log \frac{|y_{fe}|^2}{4g_{ie}g_{oe}}$$

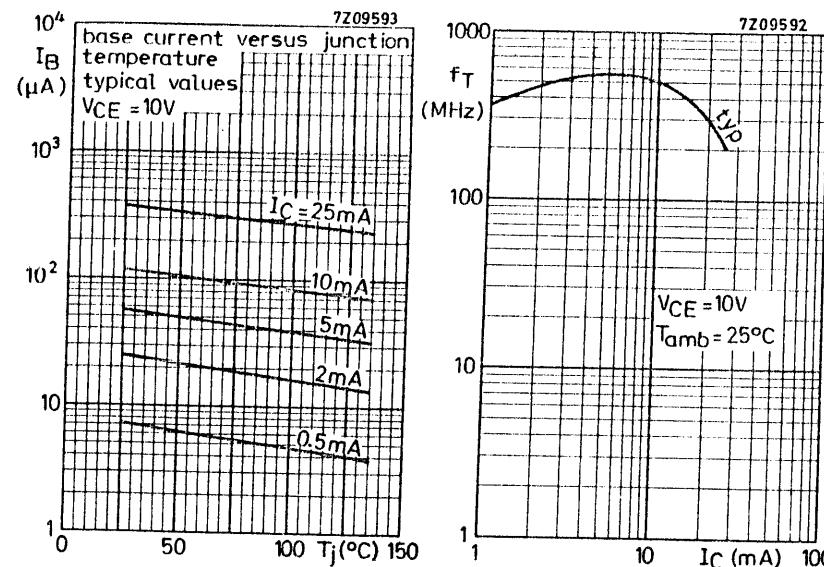
I_C = 7 mA; V_{CE} = 10 VG_{UM} typ. 43 41 dB

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

2) See also page 4.

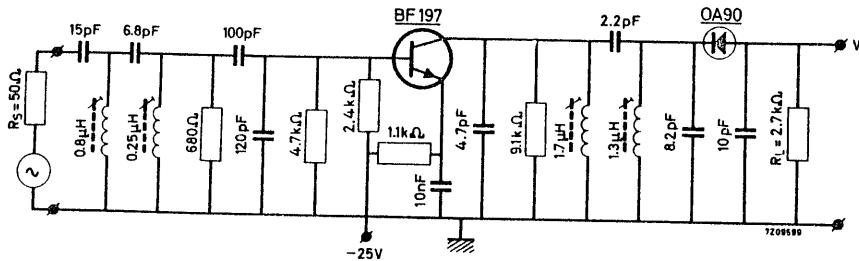
T_{amb} = 25 °C unless otherwise specified





APPLICATION INFORMATION

Output stage of a television video i.f. amplifier with the BF197 transistor, followed by a video detector circuit. 1)



1) Application information bulletins are available on request.

APPLICATION INFORMATION (continued)

Video detector output voltage at $f = 38.9$ MHz ¹⁾

$I_C = 7.2$ mA; $V_{CE} = 16.6$ V

$V_O > . . . 6$ V
typ. 7.7 V

Transducer gain at $f = 36.4$ MHz

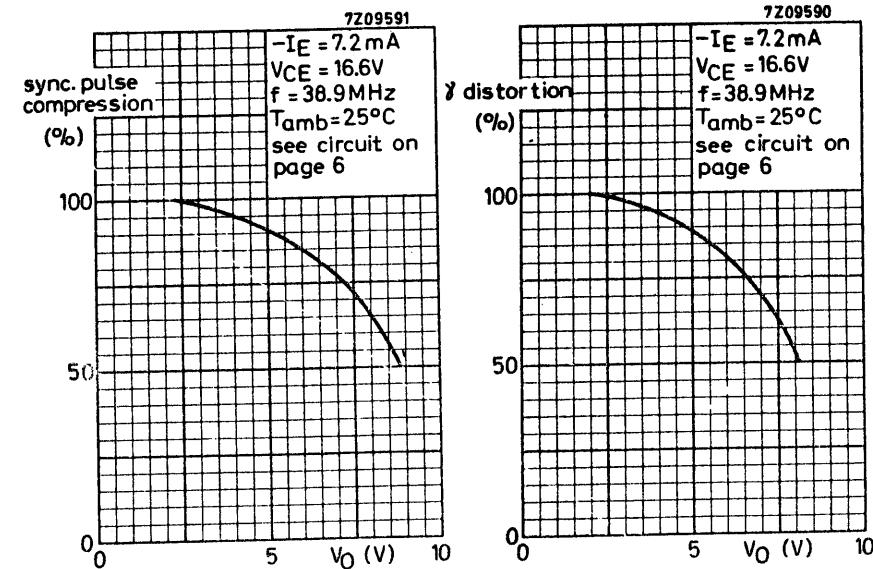
$$G_{tr} \text{ (in dB)} = 10 \log \frac{\text{output power in load } R_L}{\text{available power from source with } R_S}$$

$I_C = 7.2$ mA; $V_{CE} = 16.6$ V

G_{tr} typ. 25.5 dB

Tuning frequency for all tuned circuits is 37 MHz

1) The output voltage V_O is defined as the voltage across the $2.7 k\Omega$ detector load R_L for 30% synchronisation pulse compression.



SILICON PLANAR TRANSISTOR

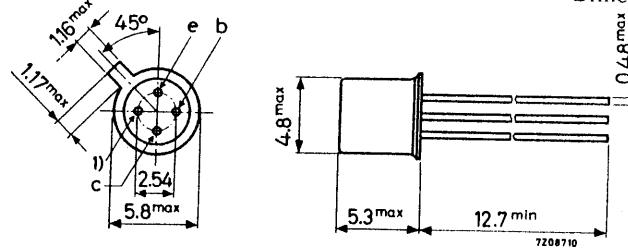
N-P-N transistor in a TO-72 metal envelope with insulated electrodes and a shield lead connected to the case. The BF200 is primarily intended for application in a forward gain controlled pre-amplifier in v.h.f. television tuners and f.m. tuners.

QUICK REFERENCE DATA			
Collector-base voltage (open emitter)	V_{CBO}	max.	30 V
Collector-emitter voltage (open base)	V_{CEO}	max.	20 V
Collector current (d.c.)	I_C	max.	20 mA
Total power dissipation up to $T_{amb} = 25^\circ\text{C}$	P_{tot}	max.	150 mW
Junction temperature	T_j	max.	175 $^\circ\text{C}$
Transition frequency $-I_E = 3 \text{ mA}; V_{CB} = 10 \text{ V}$	f_T	typ.	650 MHz
Max. unilateralised power gain $-I_E = 3 \text{ mA}; V_{CB} = 10 \text{ V}; f = 50 \text{ MHz}$ $f = 200 \text{ MHz}$	G_{UM}	typ.	30 dB
	G_{UM}	typ.	22 dB
Noise figure at optimum source admittance $-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 100 \text{ MHz}$ $-I_E = 3 \text{ mA}; V_{CB} = 10 \text{ V}; f = 200 \text{ MHz}$	F	typ.	2 dB
	F	typ.	2.7 dB

MECHANICAL DATA

TO-72

Dimensions in mm



1) = shield lead (connected to case)
Accessories available: 56246, 56263

RATINGS (Limiting values) ¹⁾Voltages

Collector-base voltage (open emitter)	V_{CBO}	max.	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	20	V
Collector-emitter voltage ($R_{BE} \leq 1 \text{ k}\Omega$)	V_{CER}	max.	30	V
Emitter-base voltage (open collector)	V_{EBO}	max.	3	V

Currents

Collector current (d.c.)	I_C	max.	20	mA
Collector current (peak value)	I_{CM}	max.	20	mA

Power dissipation

Total power dissipation up to $T_{amb} = 25^\circ\text{C}$	P_{tot}	max.	150	mW
--	-----------	------	-----	----

Temperatures

Storage temperature	T_{stg}	-65 to +175	$^\circ\text{C}$
Junction temperature	T_j	max.	175 $^\circ\text{C}$

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th j-a}$	=	1	$^\circ\text{C}/\text{mW}$
--------------------------------------	--------------	---	---	----------------------------

CHARACTERISTICS $T_{amb} = 25^\circ\text{C}$ unless otherwise specifiedBase current

$-I_E = 3 \text{ mA}; V_{CB} = 10 \text{ V}$	I_B	typ.	100	μA
$-I_E = 12 \text{ mA}; V_{CB} = 7 \text{ V}$	I_B	<	200	μA

Emitter-base voltage

$-I_E = 3 \text{ mA}; V_{CB} = 10 \text{ V}$	$-V_{EB}$	typ.	0.75	V
$-I_E = 12 \text{ mA}; V_{CB} = 7 \text{ V}$	$-V_{EB}$	<	1.0	V

Transition frequency

$-I_E = 3 \text{ mA}; V_{CB} = 10 \text{ V}$	f_T	typ.	650	MHz
--	-------	------	-----	-----

Feedback capacitance at $f = 10.7 \text{ MHz}$

$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$	$-C_{re}$	typ.	280	fF ¹⁾
---	-----------	------	-----	------------------

Noise figure at optimum source admittance

$-I_E = 3 \text{ mA}; V_{CB} = 10 \text{ V}; f = 50 \text{ MHz}$	F	typ.	1.9	dB
$f = 200 \text{ MHz}$	F	typ.	2.7	dB
$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 100 \text{ MHz}$	F	typ.	2.0	dB

Maximum unilateralised power gain ²⁾

$$G_{UM} = \frac{|y_{fb}|^2}{4 g_{ibgob}}$$

$-I_E = 3 \text{ mA}; V_{CB} = 10 \text{ V}; f = 50 \text{ MHz}$	G_{UM}	typ.	30	dB
$f = 200 \text{ MHz}$	G_{UM}	typ.	22	dB
$-I_E = 2 \text{ mA}; V_{CB} = 10 \text{ V}; f = 100 \text{ MHz}$	G_{UM}	typ.	28	dB

¹⁾ 1 fF = 1 femtofarad = 10^{-15} F .²⁾ Common base configuration, metal envelope connected to earth directly, external lead length = 3 mm.¹⁾ Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

CHARACTERISTICS (continued) $T_{amb} = 25^{\circ}\text{C}$ unless otherwise specifiedy parameters at $f = 100 \text{ MHz}$ (common emitter) $I_C = 2 \text{ mA}; V_{CE} = 10 \text{ V}$

Input conductance

 g_{ie} typ. $5 \text{ m}\Omega^{-1}$

Input capacitance

 C_{ie} typ. 16 pF

Feedback admittance

 $|y_{re}|$ typ. $0.16 \text{ m}\Omega^{-1}$

Phase angle of feedback admittance

 φ_{re} typ. 270°

Transfer admittance

 $|y_{fe}|$ typ. $56 \text{ m}\Omega^{-1}$

Phase angle of transfer admittance

 φ_{fe} typ. 340°

Output conductance

 g_{oe} typ. $15 \text{ }\mu\Omega^{-1}$

Output capacitance

 C_{oe} typ. 0.9 pF y parameters at $f = 50 \text{ MHz}$ (common base) $-I_E = 3 \text{ mA}; V_{CB} = 10 \text{ V}$

Input conductance

 g_{ib} typ. $85 \text{ m}\Omega^{-1}$

Input susceptance

 $-b_{ib}$ typ. $15 \text{ m}\Omega^{-1}$

Feedback admittance

 $|y_{rb}|$ typ. $55 \text{ }\mu\Omega^{-1}$

Phase angle of feedback admittance

 φ_{rb} typ. 270°

Transfer admittance

 $|y_{fb}|$ typ. $85 \text{ m}\Omega^{-1}$

Phase angle of transfer admittance

 φ_{fb} typ. 165°

Output conductance

 g_{ob} typ. $15 \text{ }\mu\Omega^{-1}$

Output susceptance

 b_{ob} typ. $280 \text{ }\mu\Omega^{-1}$ y parameters at $f = 200 \text{ MHz}$ (common base) $-I_E = 3 \text{ mA}; V_{CB} = 10 \text{ V}$

Input conductance

 g_{ib} typ. $62 \text{ m}\Omega^{-1}$

Input susceptance

 $-b_{ib}$ typ. $38 \text{ m}\Omega^{-1}$

Feedback admittance

 $|y_{rb}|$ typ. $180 \text{ }\mu\Omega^{-1}$

Phase angle of feedback admittance

 φ_{rb} typ. 270°

Transfer admittance

 $|y_{fb}|$ typ. $70 \text{ m}\Omega^{-1}$

Phase angle of transfer admittance

 φ_{fb} typ. 145°

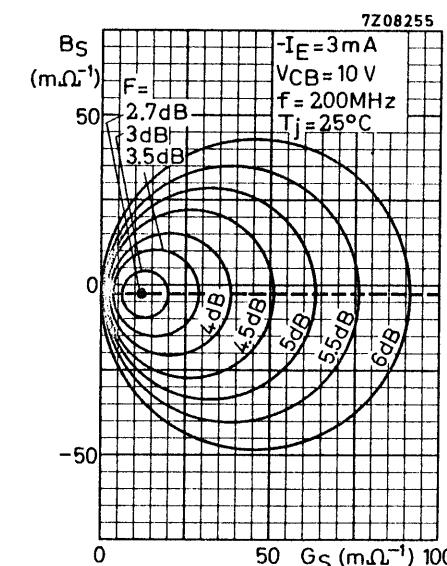
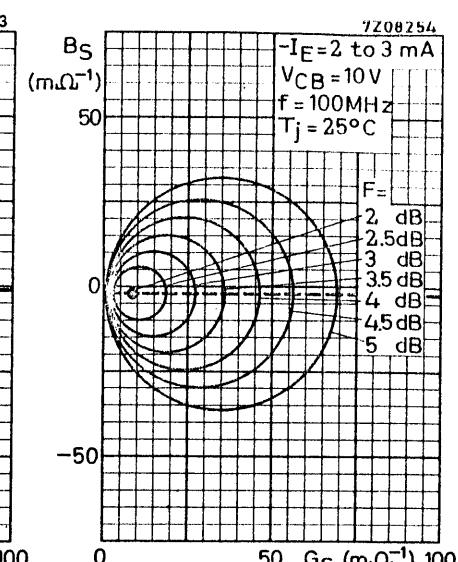
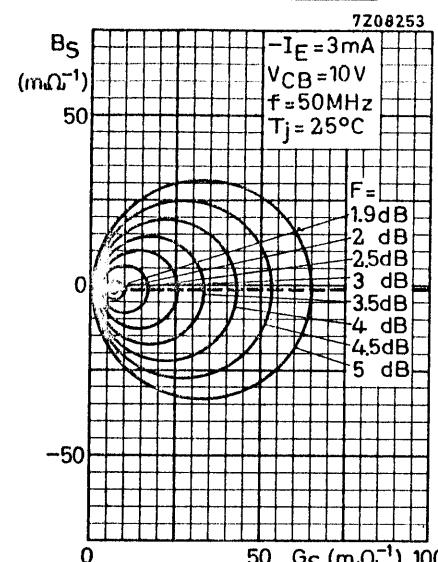
Output conductance

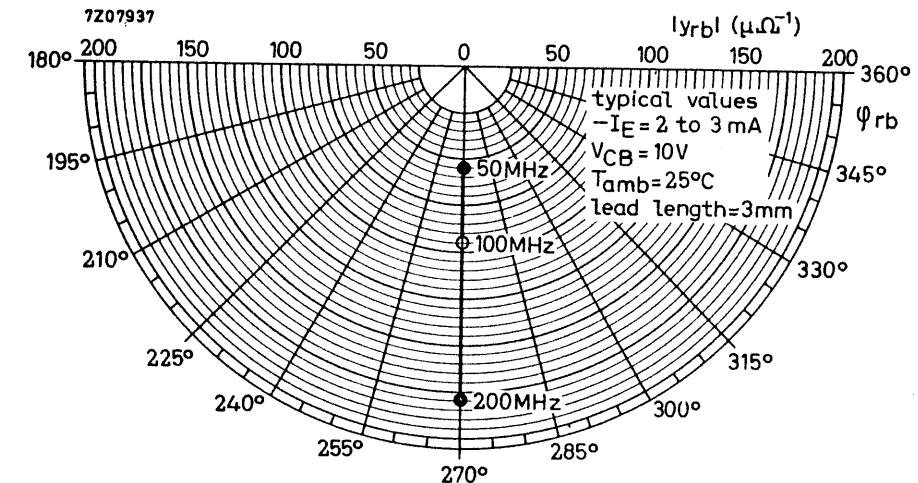
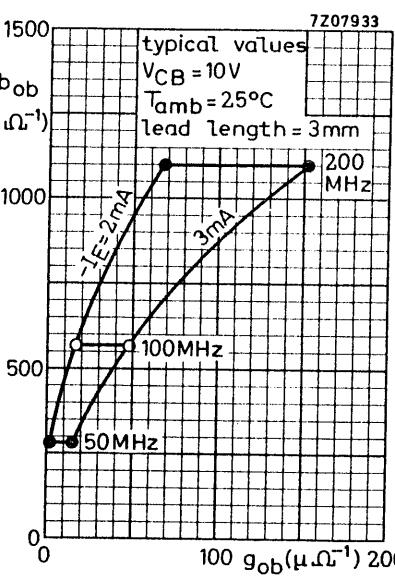
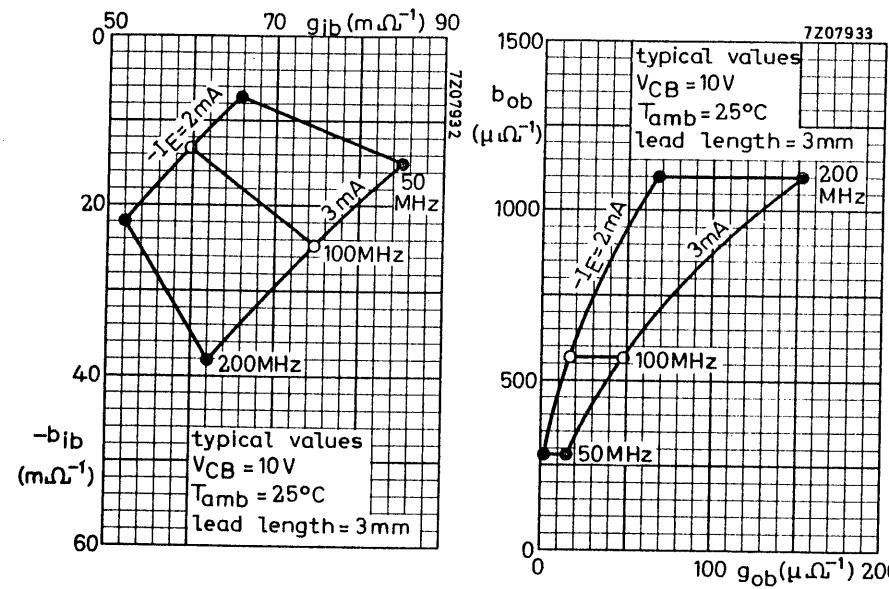
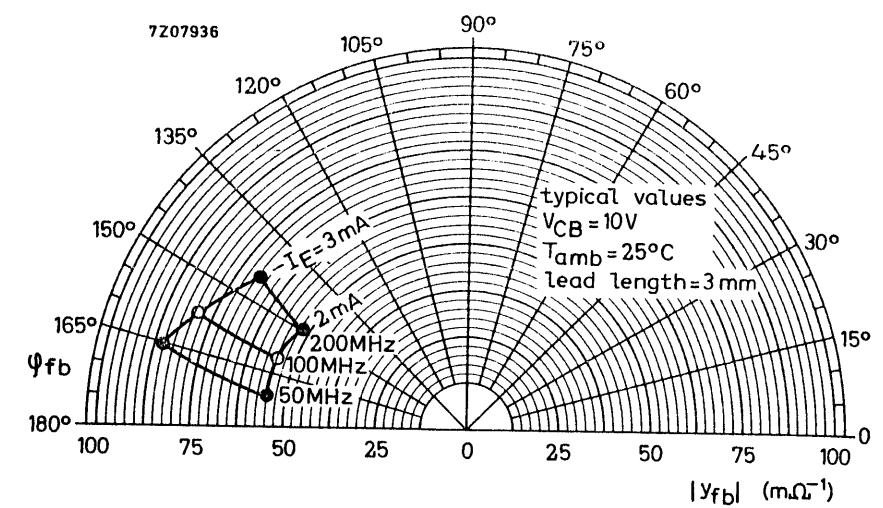
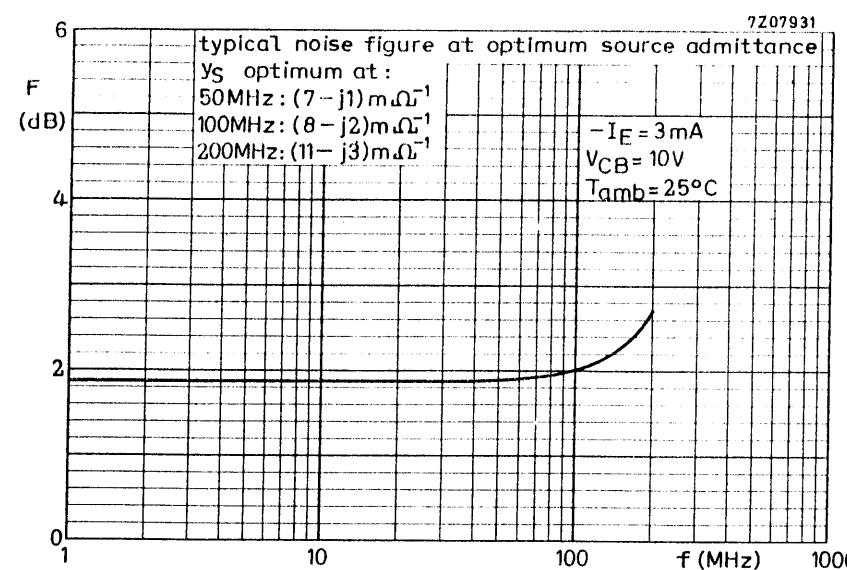
 g_{ob} typ. $150 \text{ }\mu\Omega^{-1}$

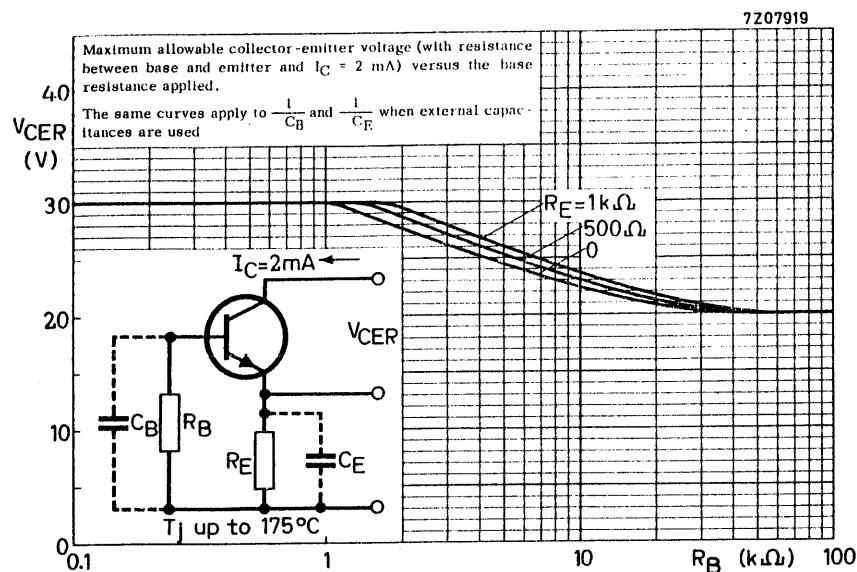
Output susceptance

 b_{ob} typ. $1.1 \text{ m}\Omega^{-1}$

circles of constant noise figure

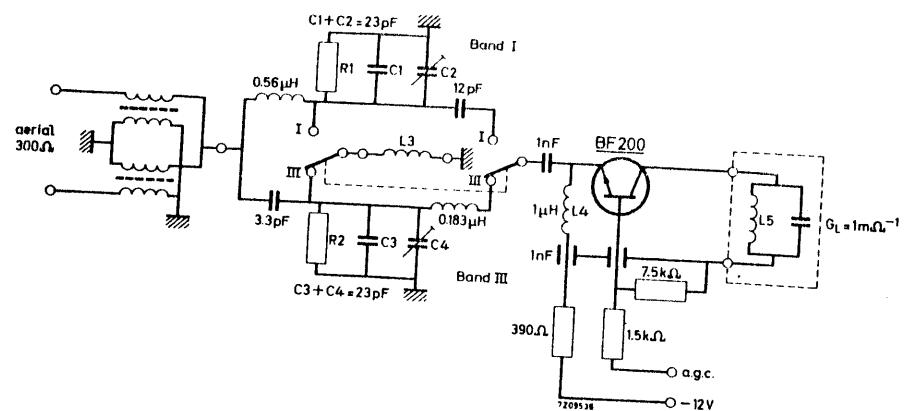






APPLICATION INFORMATION

1. R.F. stage for v.h.f. television tuner



Resistors R_1 and R_2 should be chosen so that the 3 dB bandwidth of the unloaded input circuit is 3.0 MHz with the aerial and transistor input terminals short-circuited.

Inductors L_3 and L_5 to be selected for each channel.

PERFORMANCE at $T_{\text{amb}} = 25^\circ\text{C}$ (see circuit above)

Transducer gain

$$G_{\text{tr}} = \frac{\text{output power in load } G_L}{\text{available power from aerial}}$$

$-I_E = 3 \text{ mA}; f = 50 \text{ MHz}$

$-I_E = 3 \text{ mA}; f = 200 \text{ MHz}$

G_{tr} typ. 13 dB

G_{tr} typ. 13 dB

Noise figure

$f = 50 \text{ MHz}$

$f = 200 \text{ MHz}$

F typ. 4.9 dB

F typ. 5.2 dB

Voltage standing wave ratio over the entired gain control range, measured at the vision carrier frequency

V.S.W.R. < 4

APPLICATION INFORMATION (continued)

Signal-handling capability (see next page)

In-channel cross-modulation curves of the tuner (see upper graphs); showing the interfering signal e.m.f. (in a $300\ \Omega$ aerial) that will cause a cross-modulation factor of 1% (K), plotted against ΔG_{tr} , the reduction in transducer gain caused by gain control. The broken lines indicate the signal level, assuming that gain control starts when desired aerial signal reaches 2 mV.

Measuring conditions

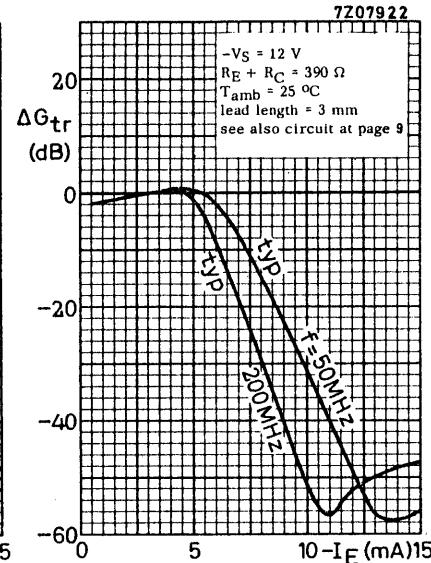
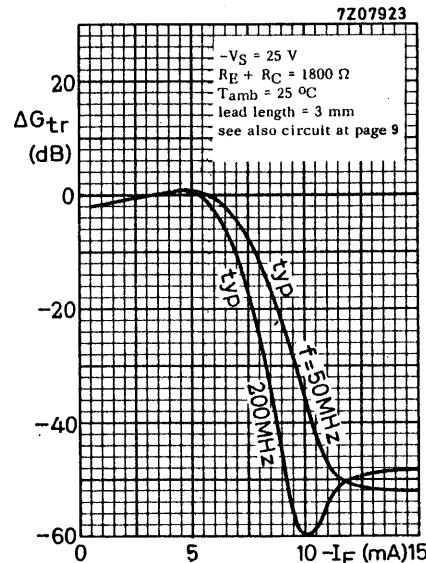
Desired signal at vision carrier frequency and interference signal at sound carrier frequency. Interference signal modulated with 4 kHz (modulation depth 100%).

In-band cross-modulation curves of the tuner; showing the interfering signal e.m.f. (in a $300\ \Omega$ aerial) that will cause a cross-modulation factor of 1% (K), plotted against ΔG_{tr} , the reduction in transducer gain caused by gain control.

Measuring conditions

Desired signal at the vision carrier frequency and interference signal, 14 MHz above the desired signal. Interference signal modulated with 4 kHz (modulation depth 100%).

APPLICATION INFORMATION bulletins available on request



APPLICATION INFORMATION (continued)

In-channel cross-modulation curves

7Z07925
channel 2

$-V_S = 12\text{ V}$
 $R_E + R_C = 390\ \Omega$
 $-V_S = 25\text{ V}$
 $R_E + R_C = 1800\ \Omega$
 $T_{amb} = 25^\circ\text{C}$
see also circuit on page 9

$K = 1\%$

V_{int} (mV)

ΔG_{tr} (dB) -75

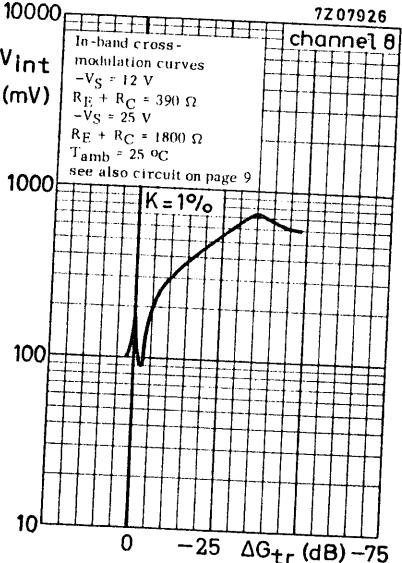
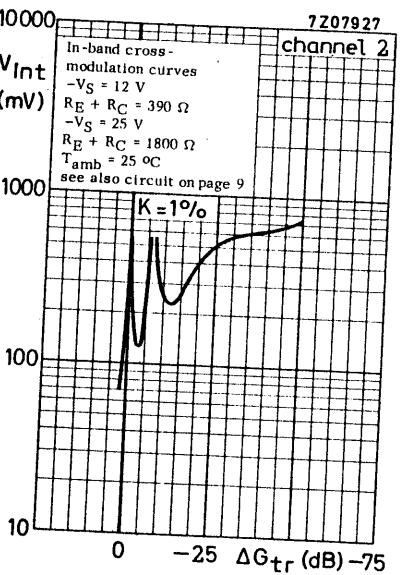
7Z07924
channel 8

$-V_S = 12\text{ V}$
 $R_E + R_C = 390\ \Omega$
 $-V_S = 25\text{ V}$
 $R_E + R_C = 1800\ \Omega$
 $T_{amb} = 25^\circ\text{C}$
see also circuit on page 9

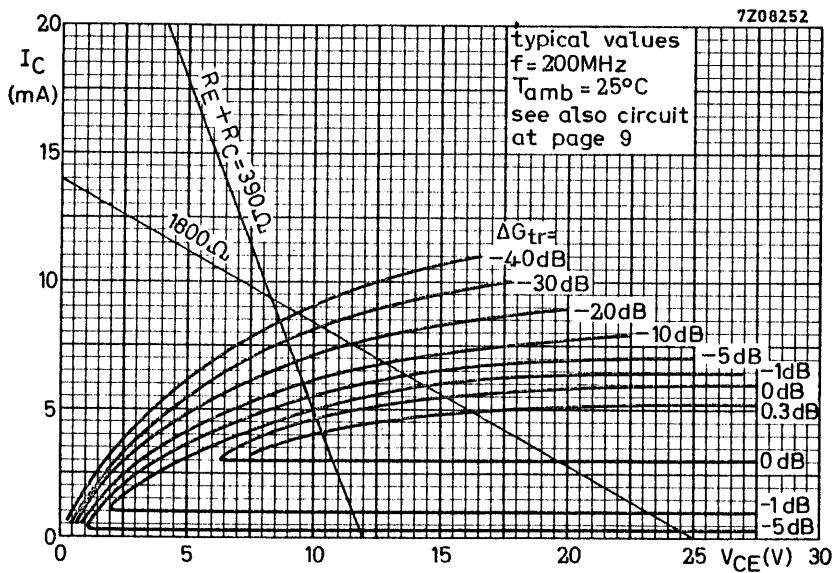
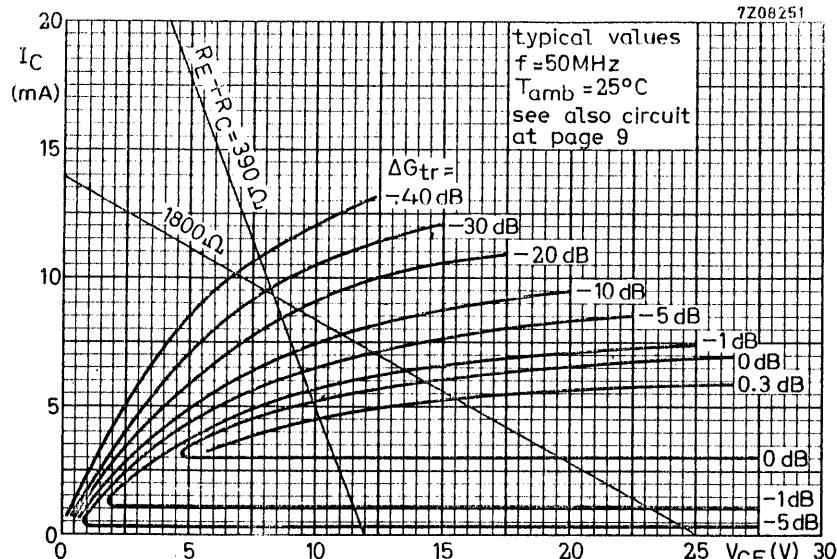
$K = 1\%$

V_{int} (mV)

ΔG_{tr} (dB) -75

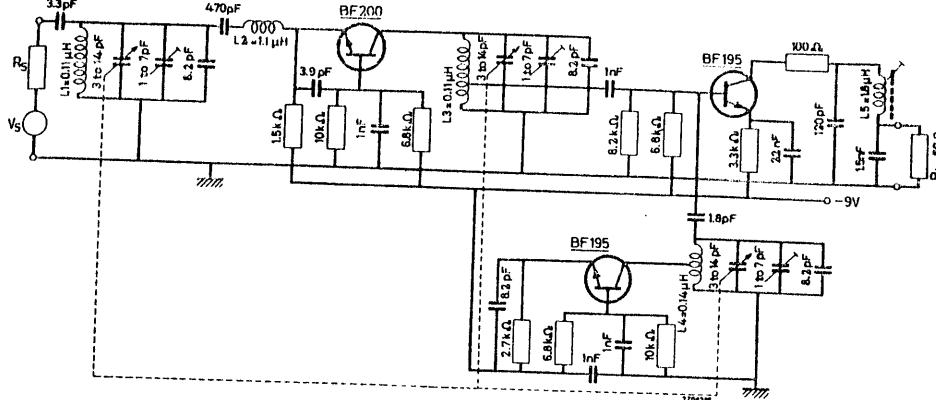


APPLICATION INFORMATION (continued)
curves of constant gain reduction



APPLICATION INFORMATION (continued)

2. F. M. tuner with a BF200 in the pre-amplifier stage.



Coil data:

$L_1 = 4$ turns enamelled Cu wire (1 mm); int. diam. 8 mm; winding pitch 2 mm; air;
 $Q_0 = 200$; $Q_L = 50$

$L_2 = 22$ turns closely wound enamelled Cu wire (0.2 mm); int. diam. 4 mm; $Q_0 = 150$

$L_3 = 4$ turns enamelled Cu wire (1 mm); int. diam. 8 mm; winding pitch 2 mm; air;
mixer base tap 3/4 turns from earth-side; $Q_0 = 200$; $Q_L = 100$

$L_4 = 4.5$ turns enamelled Cu wire (1 mm); int. diam. 8 mm; winding pitch 2 mm; air;
oscillator collector tap 3.5 turns from earth-side; $Q_0 = 200$

$L_5 = 11$ turns enamelled Cu wire (0.2 mm); winding pitch 0.4 mm; $Q_0 = 150$

Coil former AP3016/02

Can AP3015/02

Ferroxcube core 3122 104 93041

Ferroxcube frame AP3014/02

APPLICATION INFORMATION (continued)

Typical performance of the f.m. tuner at $T_{amb} = 25^{\circ}\text{C}$; $f = 98\text{ MHz}$ (oscillator frequency lower than tuning frequency)

Noise figure

$$\text{Transducer gain } G_{tr} = \frac{\text{output power in load}}{\text{available power from source}}$$

Image rejection

Double beat suppression ($V_S = 1\text{ }\mu\text{V}$; emf; $R_S = 50\text{ }\Omega$)

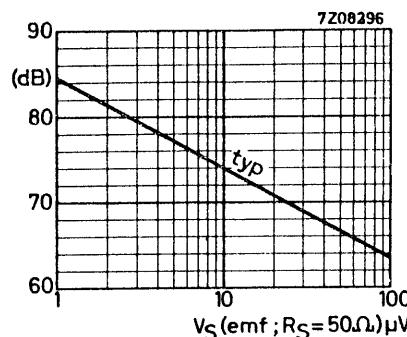
Repeat spot suppression ($V_S = 1\text{ }\mu\text{V}$; emf; $R_S = 50\text{ }\Omega$)

Oscillator frequency variation at $\Delta V_B = 2\text{ V}$

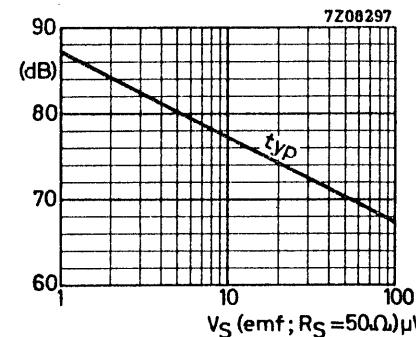
Signal handling for $\Delta f_{osc} = 20\text{ kHz}$ (emf; $R_S = 50\text{ }\Omega$)

F	4.5 dB
G_{tr}	33 dB
	65 dB
	85 dB
	87 dB
Δf_{osc}	< 20 kHz
	> 1 V

Double beat suppression



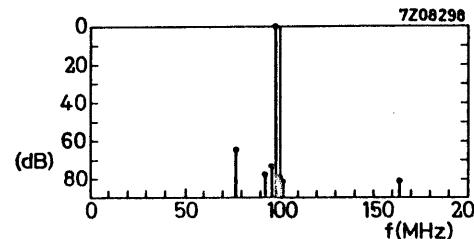
Repeat spot suppression



Spurious response suppression

Tuner adjusted to $f = 98\text{ MHz}$.

Reference level of wanted source signal: $8\text{ }\mu\text{V}$ (emf; $R_S = 50\text{ }\Omega$) = 0 dB.



HIGH FREQUENCY PACKAGE

The high frequency package 40820 contains three silicon transistors selected from the BF194 and BF195 products.

The BF194B is intended for use as mixer-oscillator transistor, the BF195C for controlled first i.f. transistor, the BF195D for second i.f. transistor.

The low hFE spread of the transistors makes it possible to apply current biasing (one base resistor) and achieve a gain with small spread and low dependence on supply voltage, even at low battery voltages. The transistors have a plastic envelope with stiff, self-locking pins suitable for use with standard printed wiring-boards.

QUICK REFERENCE DATA

Base current

$$I_C = 1\text{ mA}; V_{CE} = 10\text{ V}$$

BF194B	I_B	5 to 9	μA
BF195C	I_B	9 to 14	μA
BF195D	I_B	14 to 26	μA

Conversion noise figure of mixer BF194B

$$I_C = 1\text{ mA}; V_{CE} = 10\text{ V}$$

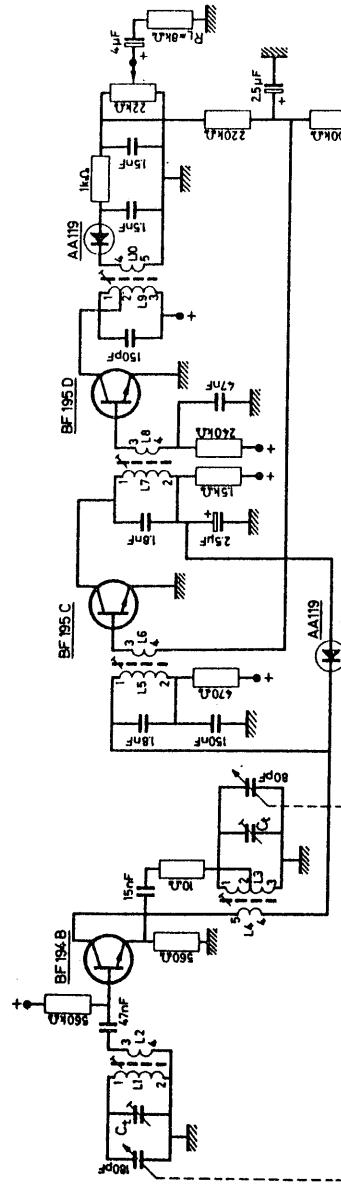
$$G_S = 1.0\text{ m}\Omega^{-1}; f = 1\text{ MHz}$$

$$F_c \quad \text{typ.} \quad 2 \quad \text{dB}$$

FOR THE DATA OF THE INDIVIDUAL TRANSISTORS PLEASE
REFER TO THE DATA SHEETS OF THE BF194 AND THE BF195

APPLICATION INFORMATION

H.F. section of a 6 V medium wave portable radio receiver



COIL DATA

L1 = 450 μ H; Q0 at f = 1 MHz : 120

$$\text{Voltage ratio } \frac{n_3 - 4}{n_1 - 2} : 5.7 \times 10^{-2}$$

L3 = 260 μ H; Q0 at f = 1.2 MHz : 120

$$\text{Voltage ratio } \frac{n_2 - 3}{n_1 - 3} : 3 \times 10^{-2}$$

$$\text{Voltage ratio } \frac{n_4 - 5}{n_1 - 3} : 5.4 \times 10^{-2}$$

L5 = 170 μ H; Q0 at f = 0.45 MHz : 80

$$\text{Voltage ratio } \frac{n_3 - 4}{n_1 - 2} : 7.35 \times 10^{-2}$$

L9 = 800 μ H; Q0 at f = 0.45 MHz : 110

$$\text{Voltage ratio } \frac{n_2 - 3}{n_1 - 3} : 41.5 \times 10^{-2}$$

$$\text{Voltage ratio } \frac{n_4 - 5}{n_1 - 3} : 59.2 \times 10^{-2}$$

PERFORMANCE at f = 1 MHz; Tamb = 25 °C

Supply voltage (from 6 V, via a RC-smoothing filter)

I_{tot} = 3 mA

ΔG = +3.6 dB

Gain spread of the h.f. part

Signal handling capability

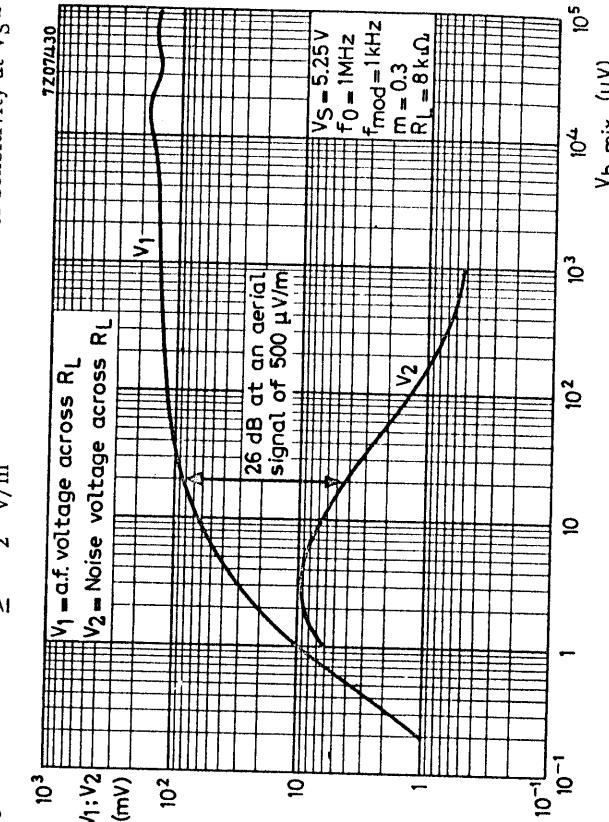
d_{tot} = 10%; m = 0.8

Sensitivity

Signal to obtain V_o = 10 mV across R_L = 8 k Ω

Signal to obtain 26 dB signal/noise ratio

Decrease of sensitivity at V_S ≈ 3.2 V 15 dB



CHARACTERISTICS

y parameters (common emitter)

$I_C = 1 \text{ mA}; V_{CE} = 10 \text{ V}$ (lead length = 3 mm)		$f = 10.7 \text{ MHz}$	$f = 0.45 \text{ MHz}$
Input conductance	BF194B :	$g_{ie} < 0.5$	$0.4 \text{ m}\Omega^{-1}$
	BF195C :	$g_{ie} < 0.64$	$0.54 \text{ m}\Omega^{-1}$
	BF195D :	$g_{ie} < 0.95$	$0.85 \text{ m}\Omega^{-1}$
Output conductance	BF194B :	g_{oe} typ. 10 < 13.5	$6.5 \mu\Omega^{-1}$ $11.5 \mu\Omega^{-1}$
	BF195C :	g_{oe} typ. 6.5 < 9.5	$4 \mu\Omega^{-1}$ $7 \mu\Omega^{-1}$
	BF195D :	g_{oe} typ. 4 < 9.5	$2 \mu\Omega^{-1}$ $7 \mu\Omega^{-1}$

PACKAGE FOR COLOUR DIFFERENCE AMPLIFIERS

The package 40822 consists of three n-p-n silicon planar transistors BF179A; BF179B and BF179C, intended for application in colour difference amplifiers of television receivers.

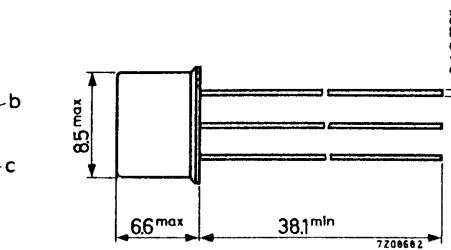
The BF179A is meant for the G-Y amplifier,
the BF179B for the R-Y amplifier and
the BF179C for the B-Y amplifier.

QUICK REFERENCE DATA			
	G-Y amplifier	R-Y amplifier	B-Y amplifier
Peak-peak output voltage	100	170	200
Bandwidth (3 dB)	1	1	1
Transient response			
rise time		300 ns	
fall time		300 ns	
overshoot		< 5 %	

MECHANICAL DATA

Dimensions in mm

TO-5
Collector connected to case



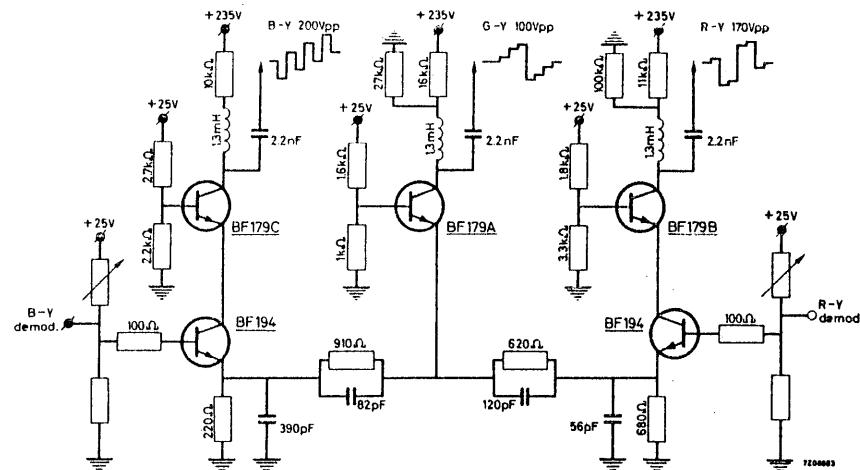
Accessories available: 56218; 56245; 56265

MOUNTING METHODS see page 5

APPLICATION INFORMATION

Application as colour difference amplifier

The circuit below is able to drive shadow mask colour picture tubes with screen sizes up to 25".



Performance up to $T_{amb} = 55^{\circ}\text{C}$

	G-Y amplifier	R-Y amplifier	B-Y amplifier
Gain		30	50
Peak-peak output voltage	100	170	200 V
Bandwidth (3 dB)	1	1	1 MHz ¹⁾
Transient response ¹⁾			
rise time	300 ns		
fall time	300 ns		
overshoot	< 5 %		

NOTE

In order not to exceed the junction temperature rating, the thermal resistance from junction to ambient should have the following values:

G-Y output stage: $R_{th j-a}$	→ 220 $^{\circ}\text{C}/\text{W}$
R-Y output stage: $R_{th j-a}$	→ 110 $^{\circ}\text{C}/\text{W}$ ²⁾
B-Y output stage: $R_{th j-a}$	→ 85 $^{\circ}\text{C}/\text{W}$ ²⁾

1) With a total load capacitance < 30 pF, including the capacitance due to the heatsink.

2) To ensure the above mentioned performance for bandwidth and transient response, the contribution of the heatsink to the total output capacitance of the device should not exceed 4 pF.

DATA OF THE INDIVIDUAL TRANSISTORS

RATINGS (Limiting values)¹⁾

Voltages

	BF179A	BF179B	BF179C	
Collector-base voltage (open emitter)	V_{CBO} max. 160	220	250	V ²⁾
Collector-emitter voltage ($R_{BE} \leq 1 \text{k}\Omega$)	V_{CER} max. 160	220	250	V ²⁾
Emitter-base voltage (open collector)	V_{EBO} max. 5	5	5	V

Currents

Collector current (d.c.)	I_C	max.	50	mA
Collector current (peak value)	I_{CM}	max.	50	mA

Power dissipation

Total power dissipation up to $T_{mb} = 130^{\circ}\text{C}$ P_{tot} max. 1.7 W

Temperatures

Storage temperature	T_{stg}	-55 to +175	$^{\circ}\text{C}$
Junction temperature	T_j	max.	200 $^{\circ}\text{C}$

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th j-a}$	= 220 $^{\circ}\text{C}/\text{W}$
From junction to mounting base	$R_{th j-mb}$	= 40 $^{\circ}\text{C}/\text{W}$ ³⁾
From junction to case	$R_{th j-c}$	= 45 $^{\circ}\text{C}/\text{W}$ ³⁾

1) Limiting values according to the Absolute Maximum System as defined in IEC publication 134.

2) During switching on, a supply voltage of 1.2 times the rated V_{CER} value is permitted.

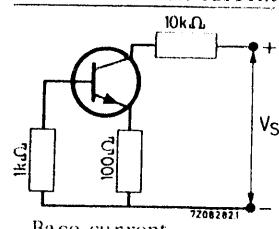
The current must be limited so that maximum dissipation and maximum junction temperature are not exceeded.(see page 6)

3) See also pages 5 and 6.

DATA OF THE INDIVIDUAL TRANSISTORS

CHARACTERISTICS

→ Collector cut-off current



$T_j = 200^\circ\text{C}$

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

BF179A; $V_{CE} = 160\text{ V}$	$I_{CER} < 1\text{ mA}$
BF179B; $V_{CE} = 220\text{ V}$	$I_{CER} < 1\text{ mA}$
BF179C; $V_{CE} = 250\text{ V}$	$I_{CER} < 1\text{ mA}$
BF179A; $V_S = 160\text{ V}$	$I_{CER} < 2\text{ mA}$
BF179B; $V_S = 225\text{ V}$	$I_{CER} < 3\text{ mA}$
BF179C; $V_S = 260\text{ V}$	$I_{CER} < 4\text{ mA}$

Base current

$I_C = 20\text{ mA}; V_{CE} = 15\text{ V}$

I_B typ. 0.45 mA
 $< 1.0\text{ mA}$

Base-emitter voltage ¹⁾

$I_C = 20\text{ mA}; V_{CE} = 15\text{ V}$

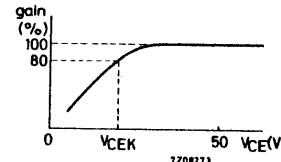
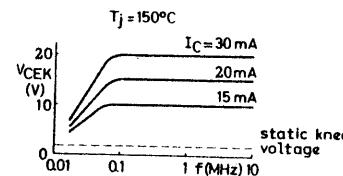
V_{BE} typ. 0.75 V
 $< 1.2\text{ V}$

High frequency knee voltage at $T_j = 150^\circ\text{C}$

$I_C = 20\text{ mA}$

V_{CEK} typ. 15 V

The high frequency knee voltage of a transistor is that value of the collector-emitter voltage at which the small signal gain, measured in a practical circuit, has dropped to 80% of the gain at $V_{CE} = 50\text{ V}$. A further decrease of the collector-emitter voltage results in a rapid increase of the distortion of the signal.



→ Feedback capacitance

$I_C = 10\text{ mA}; V_{CE} = 20\text{ V}; f = 0.5\text{ MHz}$

$-C_{re}$ typ. 1.8 pF
 $< 3.5\text{ pF}$

Feedback time constant

$-I_E = 10\text{ mA}; V_{CB} = 15\text{ V}; f = 10\text{ MHz}$

$r_{bb'}C_{b'c}$ typ. 20 ps
 $< 100\text{ ps}$

Transition frequency

$I_C = 10\text{ mA}; V_{CE} = 15\text{ V}$

f_T typ. 120 MHz

¹⁾ V_{BE} decreases by about $1.6\text{ mV}/^\circ\text{C}$ with increasing temperature.

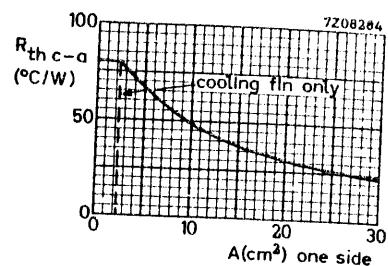
DATA OF THE INDIVIDUAL TRANSISTORS

MOUNTING METHODS

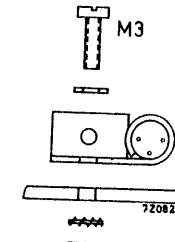
1. Transistor mounted with cooling fin 56265 on a heatsink ($R_{th j-c} = 45\text{ }^\circ\text{C/W}$)
 $R_{th j-a} = R_{th j-c} + R_{th c-a}$. $R_{th c-a}$ includes the contact thermal resistance

Heatsink material:

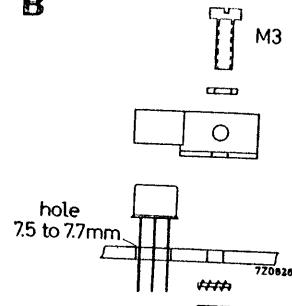
1.5 mm aluminium, blackened



A



B



Torque on nut (for good heat transfer): 5 cm kg

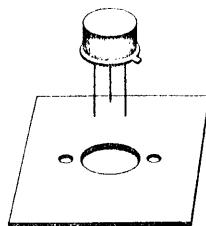
DATA OF THE INDIVIDUAL TRANSISTORS

MOUNTING METHODS (continued)

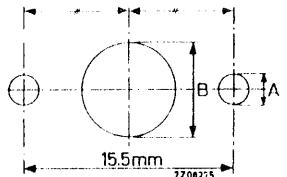
2. Transistor mounted directly on a heatsink ($R_{th\ j-mb} = 40\ ^\circ C/W$)

$$R_{th\ mb-h} \approx 3\ ^\circ C/W$$

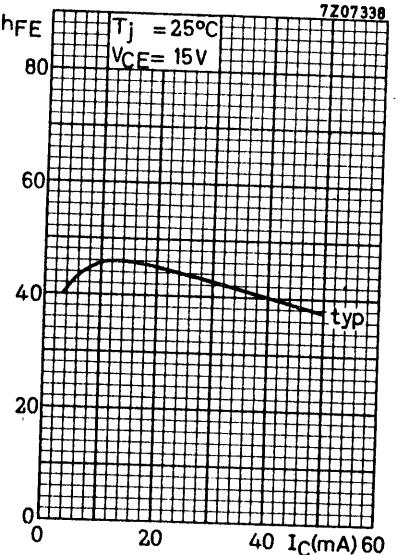
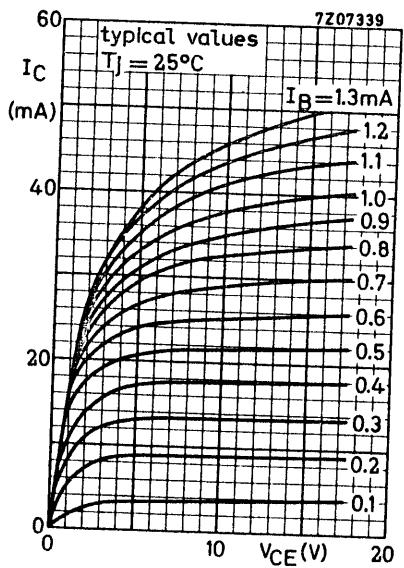
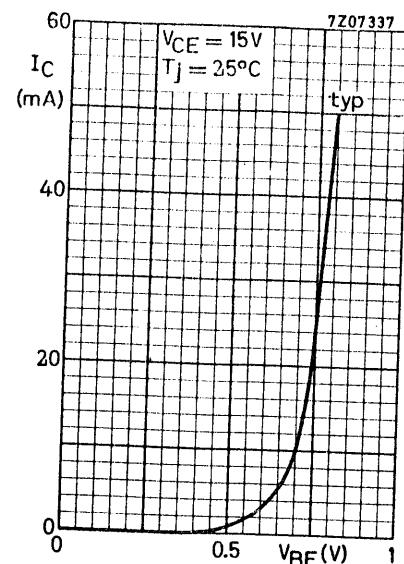
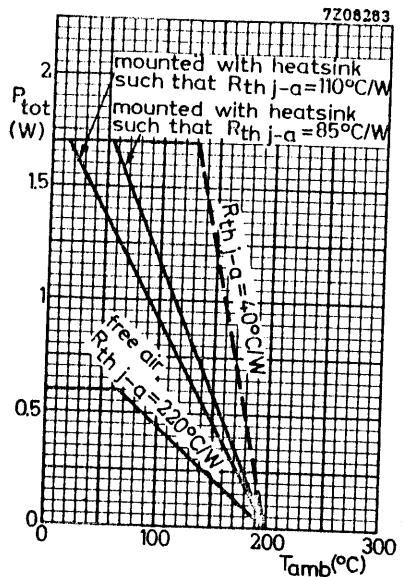
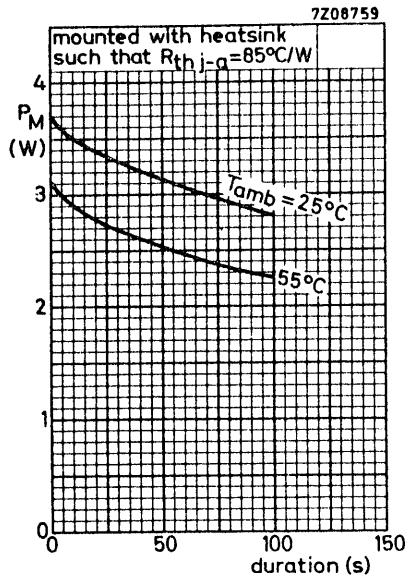
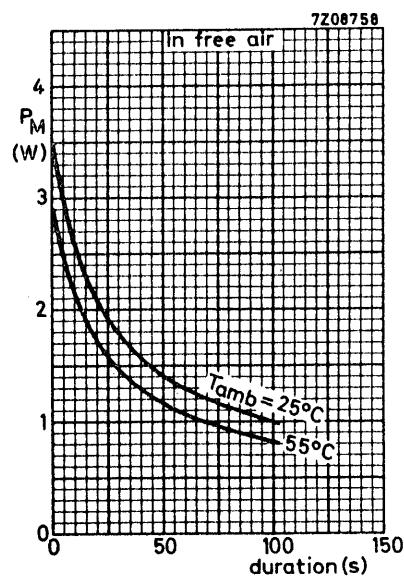
clamping washer of insulating material from accessory 56218

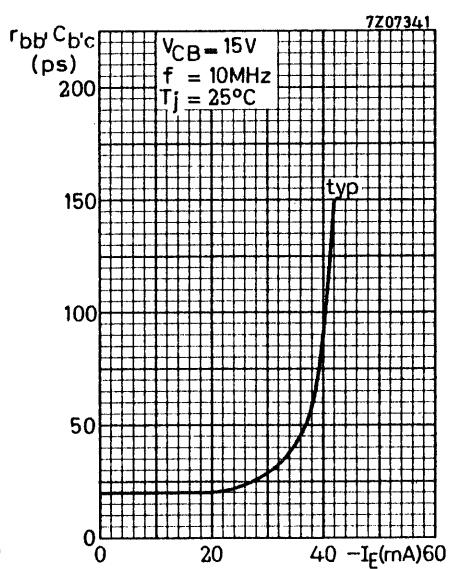
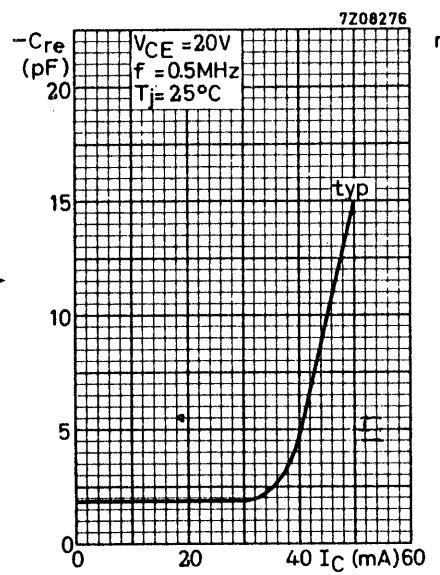
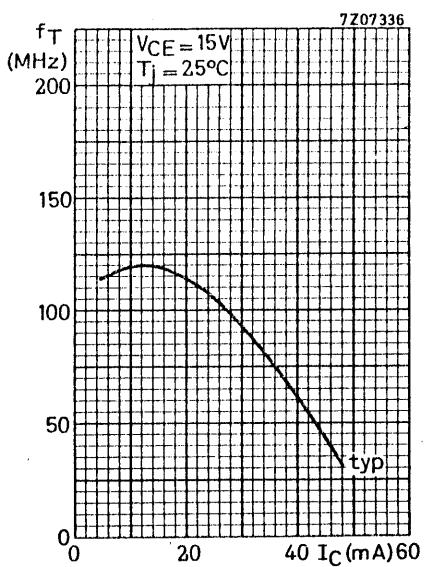
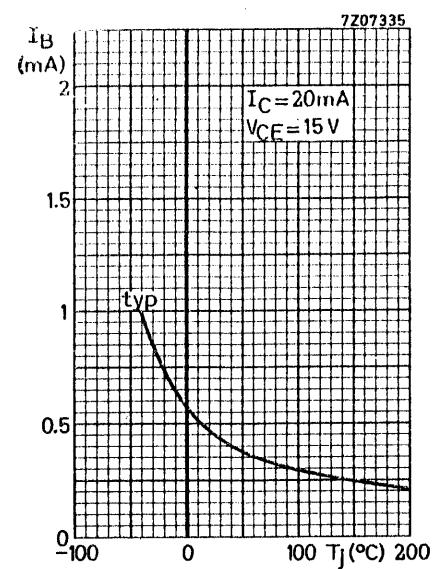


Fasten with M2.6 bolts



maximum allowable peak power dissipation versus duration



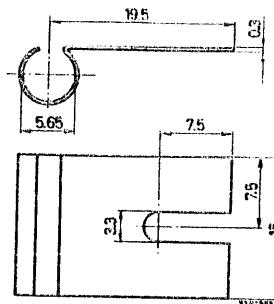


DISSIPATORI
E ACCESSORI

COOLING FIN

MECHANICAL DATA

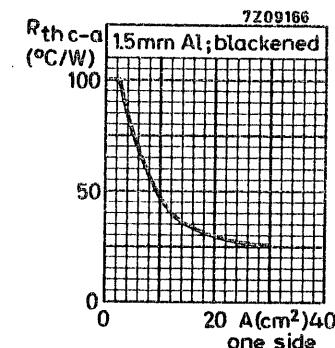
Dimensions in mm



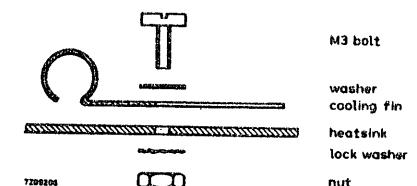
Fin material: brass, nickel plated

THERMAL RESISTANCE

From case to ambient with cooling fin only
with heatsink

 $R_{th\ c-a} = 100 \text{ }^{\circ}\text{C/W}$
see graph


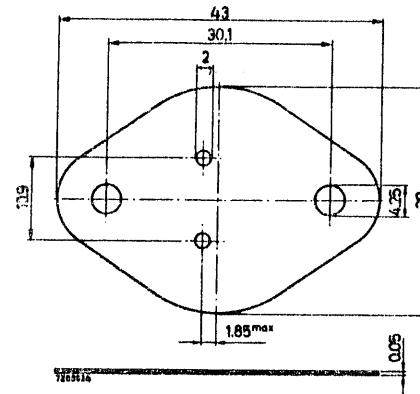
MOUNTING INSTRUCTIONS



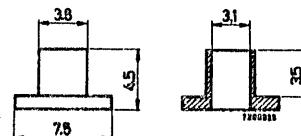
Torque on nut for good heat transfer: 5 cm kg

56201a MICA WASHER AND 2 INSULATING BUSHES

MECHANICAL DATA



Dimensions in mm



THERMAL RESISTANCE

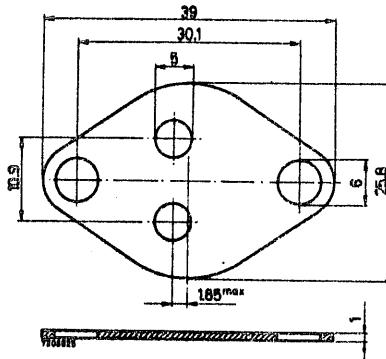
From mounting base to heatsink

$$R_{th\ mb-h} = 1.0 \text{ } ^\circ\text{C/W}$$

56201b

LEAD WASHER

MECHANICAL DATA



Dimensions in mm

56201e consists of 56201a and 56201b

THERMAL RESISTANCE

From mounting base to heatsink
with mica washer and lead washer

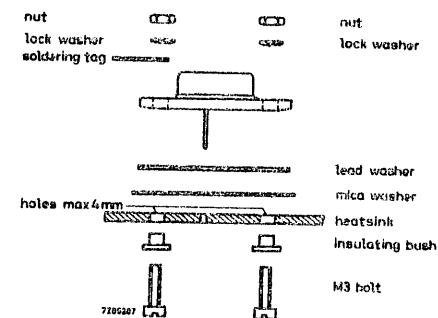
$$R_{th\ mb-h} = 0.75 \text{ } ^\circ\text{C/W}$$

TEMPERATURE

Maximum allowable temperature

$$T_{max} = 150 \text{ } ^\circ\text{C}$$

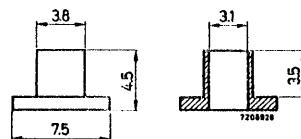
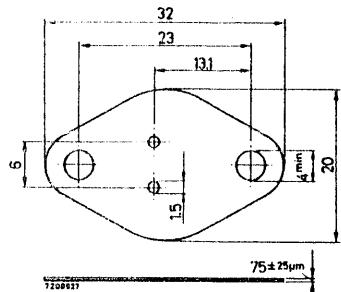
MOUNTING INSTRUCTIONS



Torque on nut for good heat transfer: 5 cm kg

MICA WASHER AND 2 INSULATING BUSHES

MECHANICAL DATA



THERMAL RESISTANCE

From mounting base to heatsink

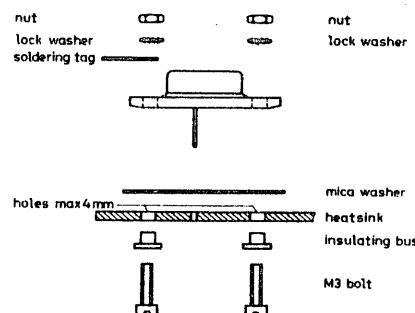
$$R_{th\ mb-h} = 1.5 \text{ } ^\circ\text{C/W}$$

TEMPERATURE

Maximum allowable temperature

$$T_{max} = 150 \text{ } ^\circ\text{C}$$

MOUNTING INSTRUCTIONS

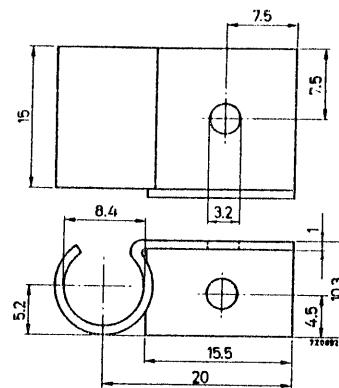


Torque on nut for good heat transfer: 5 cm kg

COOLING FIN

Dimensions in mm

MECHANICAL DATA



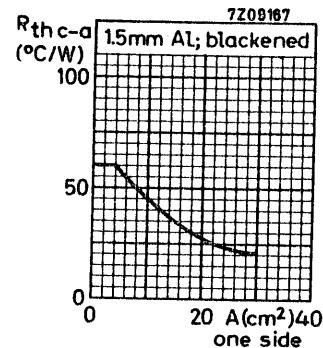
Fin material: aluminium, blackened

THERMAL RESISTANCE

From case to ambient with cooling fin only
with heatsink

$$R_{th\ c-a} = 60 \text{ } ^\circ\text{C/W}$$

see graph

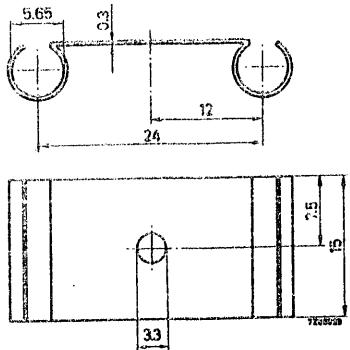


MOUNTING INSTRUCTIONS

Torque on M3 bolts for good heat transfer: 5 cm kg

COOLING FIN

MECHANICAL DATA



Dimensions in mm

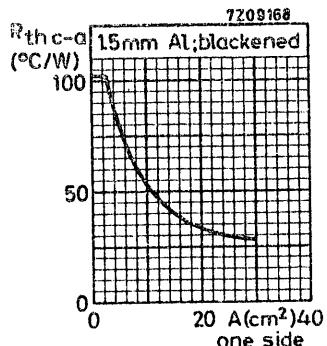
Fin material: brass, nickel plated

THERMAL RESISTANCE

From case to ambient with cooling fin only
with heatsink

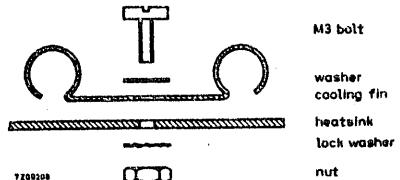
$$R_{th\ c-a} = 102 \text{ }^{\circ}\text{C/W}$$

see graph



R_{th} values apply to each transistor, provided the two transistors have been mounted so that the heat flow from each is equal.

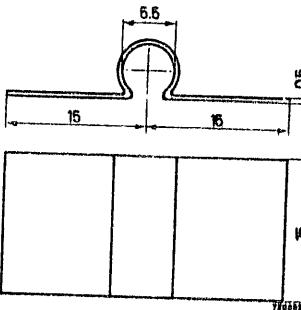
MOUNTING INSTRUCTIONS



Torque on nut for good heat transfer: 5 cmkg

COOLING FIN

MECHANICAL DATA



Dimensions in mm

Fin material: brass, nickel plated

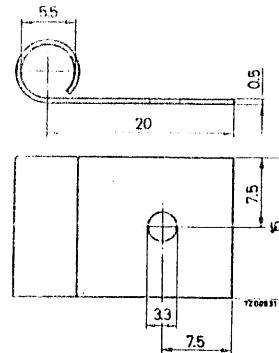
THERMAL RESISTANCE

From case to ambient with cooling fin only

$$R_{th\ c-a} = 75 \text{ }^{\circ}\text{C/W}$$

COOLING FIN

MECHANICAL DATA



Fin material: brass, nickel plated

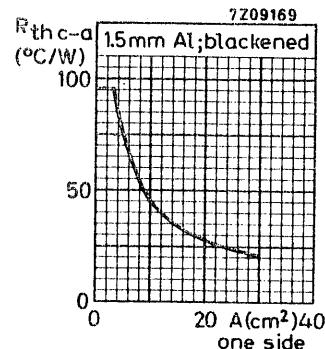
Dimensions in mm

THERMAL RESISTANCE

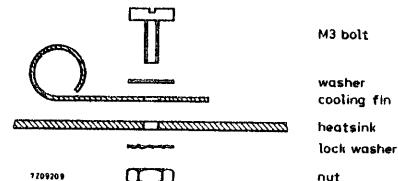
From case to ambient with cooling fin only
with heatsink

$$R_{th\ c-a} = 95 \text{ }^{\circ}\text{C/W}$$

see graph



MOUNTING INSTRUCTIONS

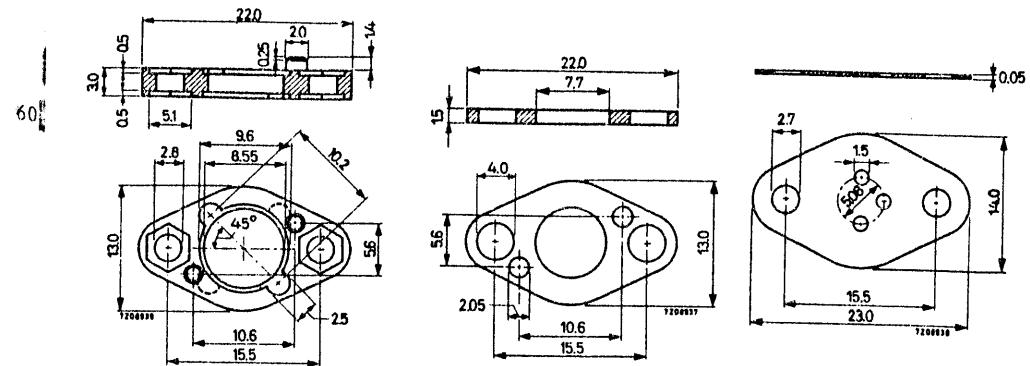


Torque on nut for good heat transfer: 5 cm kg

MOUNTING ACCESSORIES

Dimensions in mm

MECHANICAL DATA



top clamping washer
of insulating material

bottom clamping washer
material: brass, tin
plated

mylar washer

THERMAL RESISTANCE

From mounting base to heatsink non insulated mounting
insulated mounting

$$R_{th\ mb-h} = 1 \text{ }^{\circ}\text{C/W}$$

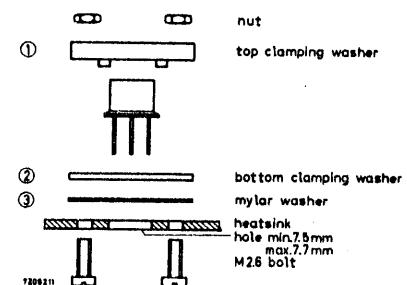
$$R_{th\ mb-h} = 6 \text{ }^{\circ}\text{C/W}$$

TEMPERATURE

Maximum allowable temperature

$$T_{max} = 100 \text{ }^{\circ}\text{C}$$

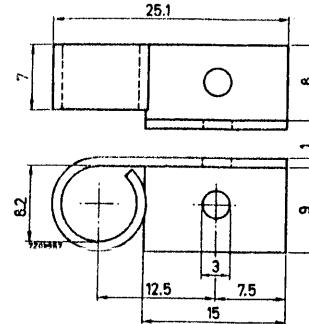
MOUNTING INSTRUCTIONS



Non insulated mounting; without items 2 and 3. (Note: Item 1 must than be mounted up-side down)

COOLING FIN

MECHANICAL DATA



Dimensions in mm

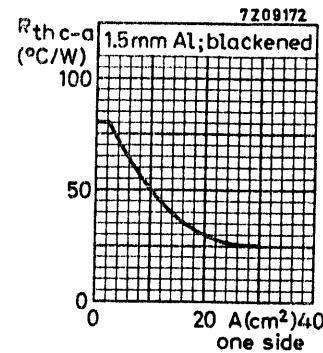
Fin material: aluminium, blackened

THERMAL RESISTANCE

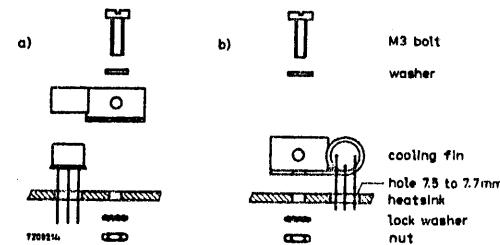
From case to ambient with cooling fin only
with heatsink

$$R_{th\ c-a} = 80 \text{ }^{\circ}\text{C/W}$$

see graph



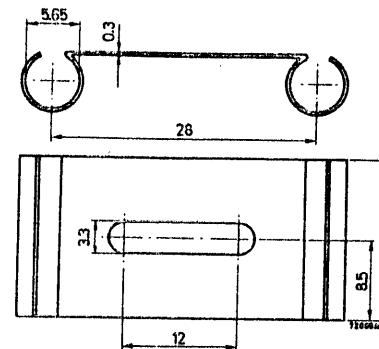
MOUNTING INSTRUCTIONS



Torque on nut for good heat transfer: 5 cm kg

COOLING FIN

MECHANICAL DATA



Dimensions in mm

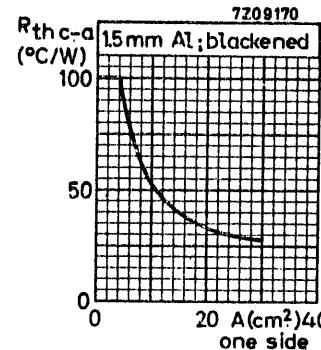
Fin material: brass, nickel plated

THERMAL RESISTANCE

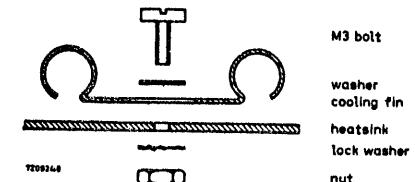
From case to ambient with cooling fin only
with heatsink

$$R_{th\ c-a} = 100 \text{ }^{\circ}\text{C/W}$$

see graph



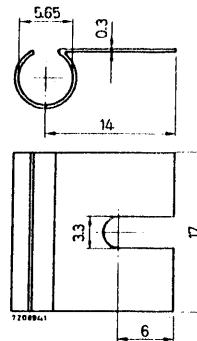
MOUNTING INSTRUCTIONS



Torque on nut for good heat transfer: 5 cm kg

COOLING FIN

MECHANICAL DATA



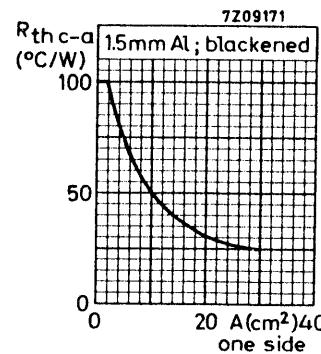
Fin material: brass, nickel plated

THERMAL RESISTANCE

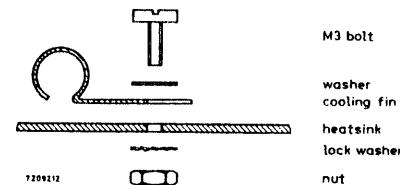
From case to ambient with cooling fin only
with heatsink

$$R_{th\ c-a} = 100 \text{ }^{\circ}\text{C/W}$$

see graph



MOUNTING INSTRUCTIONS

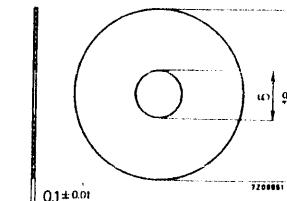


Torque on nut for good heat transfer: 5 cm kg

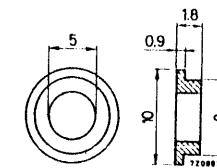
MOUNTING ACCESSORIES

Dimensions in mm

MECHANICAL DATA

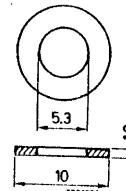


mica washer



insulating ring

Dimensions in mm



plain washer
material: brass, nickel plated

THERMAL RESISTANCE

From mounting base to heatsink
(with mica washer)

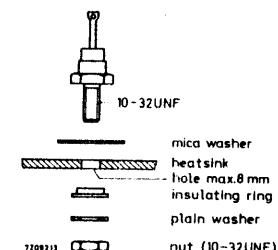
$$R_{th\ mb-h} = 1.7 \text{ }^{\circ}\text{C/W}$$

TEMPERATURE

Maximum allowable temperature

$$T_{max} = 125 \text{ }^{\circ}\text{C}$$

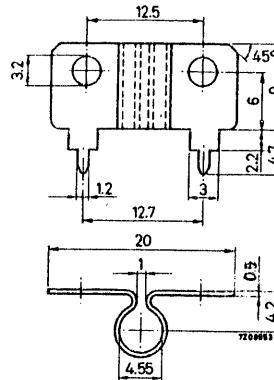
MOUNTING INSTRUCTIONS



Notes: When using a tag for electrical contact insert tag between nut and plain washer or replace plain washer by tag.

COOLING FIN

MECHANICAL DATA



Dimensions in mm

Fin material: copper, tin plated

THERMAL RESISTANCE

From case to ambient

 $R_{th\ c-a} = 100 \ ^\circ\text{C/W}$

SEZIONE ELCOMA
Reparto Microelettronica

Elenco delle documentazioni contenenti i dati tecnici dei SEMI-
 CONDUTTORI

- 173 - Equivalenti semiconduttori professionali
- 204 - Diodi di potenza a valanga controllata
- 227 - Diodi di potenza
- 228 - Semiconduttori per microonde
- 229 - Elementi fotosensibili a semiconduttore
- 236 - Transistori al germanio
- 255 - Accessori per semiconduttori professionali
- 266 - Diodi al germanio
- 270 - Equivalenti semiconduttori per radio e TV
- 280 - Transistori al silicio per commutazione e impieghi generali
- 281 - Transistori al silicio per telecomunicazioni
- 285 - Diodi Zener
- 295 - Diodi controllati al silicio e diac
- 296 - Diodi al silicio per correnti deboli
- 297 - Thyristor a valanga controllata

:-----:

Sla - Transistori al germanio e al silicio per radio e TV