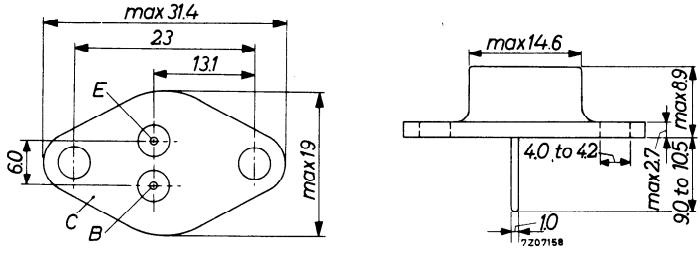
# GERMANIUM ALLOYED POWER TRANSISTOR

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 11 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 $T_{mb} = 75\,^{o}C$ | $P_{tot}$ | max. | 4 | W |
| Junction temperature (incidentally) | $T_j$ | max. | 100 | $^{o}C$ |
| D.C. current gain at $T_j = 25\,^{o}C$ | | | | |
| $I_C = 0.5$ A; $V_{CE} = 1$ V | $h_{FE}$ | 80 to | 320 | |
| Cut-off frequency | | | | |
| $I_C = 0.3$ A; $V_{CE} = 2$ V | $f_{hfe}$ | typ. | 35 | kHz |

**MECHANICAL DATA** Dimensions in mm

Collector connected to mounting base




Accessories and mounting instructions see page 4.

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**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 A) | $V_{CEX}$ | 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 $T_{mb} = 72$ °C | $P_{tot}$ | max. | 4 | 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 | $R_{th\ j\text{-}mb}$ | = | 4.5 | °C/W |
| From mounting base to heatsink with mica washer | $R_{th\ mb\text{-}h}$ | = | 1.5 | °C/W |
| without mica washer | $R_{th\ mb\text{-}h}$ | = | 0.5 | °C/W |

[1]) Limiting values according to the Absolute Maximum System as defined in IEC publication 134. 7Z3 0943

## CHARACTERISTICS

$T_j$ = 25 °C unless otherwise specified

Collector cut-off current

| | | | | |
|---|---|---|---|---|
| $I_E$ = 0; $V_{CB}$ = 32 V | $I_{CBO}$ | typ. | 20 | μA |
| | | < | 500 | μA |
| $I_E$ = 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 |

Emitter cut-off current

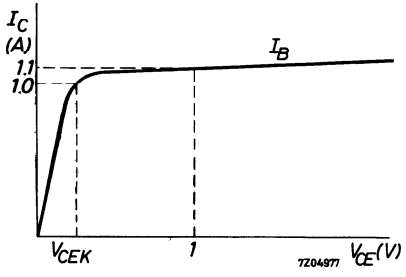
| | | | | |
|---|---|---|---|---|
| $I_C$ = 0; $V_{EB}$ = 10 V | $I_{EBO}$ | typ. | 20 | μA |
| | | < | 200 | μA |
| $I_C$ = 0; $V_{EB}$ = 10 V; $T_j$ = 90 °C | $I_{EBO}$ | < | 2 | mA |

Base-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 | mV ← |

Knee voltage

| | | | | |
|---|---|---|---|---|
| $I_C$ = 1 A; $I_B$ = value for which | | | | |
| $I_C$ = 1.1 A at $V_{CE}$ = 1 V | $V_{CEK}$ | < | 600 | 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. | 150 | pF |

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

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**CHARACTERISTICS** (continued) $T_j$ = 25 °C unless otherwise specified

D.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 | $h_{FE}$ | > | 40 |

Transition frequency

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

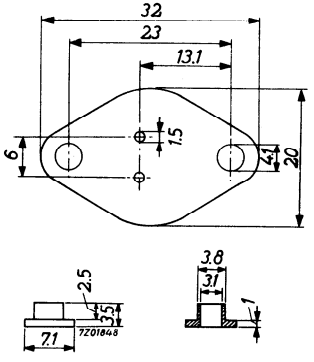
Cut-off frequency

| | | | |
|---|---|---|---|
| $I_C$ = 300 mA; $V_{CE}$ = 2 V | $f_{hfe}$ | > | 20 kHz |
| | | typ. | 35 kHz |

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

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

**ACCESSORIES AND MOUNTING INSTRUCTIONS** Dimensions in mm

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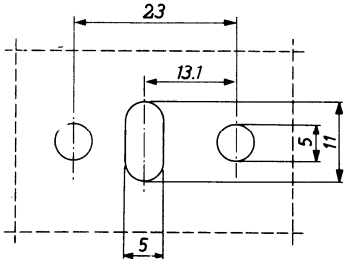
Mica washer (50 to 100 μm)
and insulation bushes




Bore-hole dimensions
for heatsink

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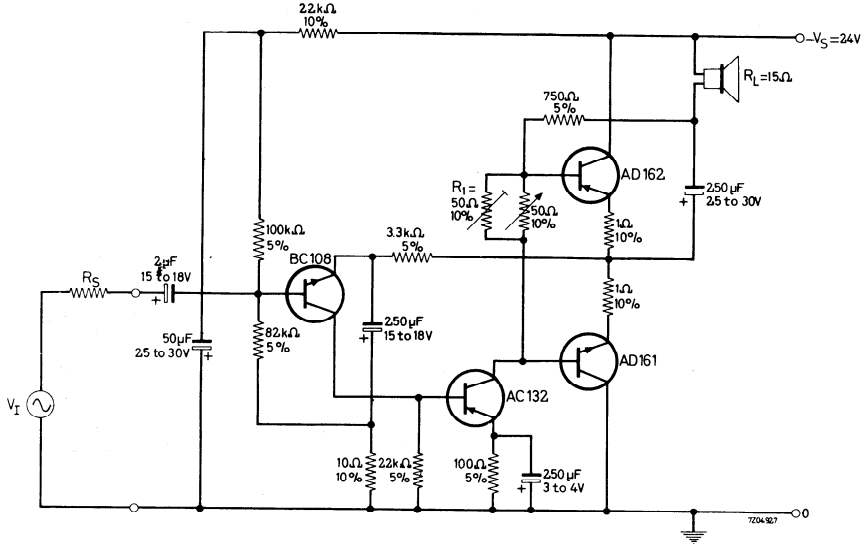
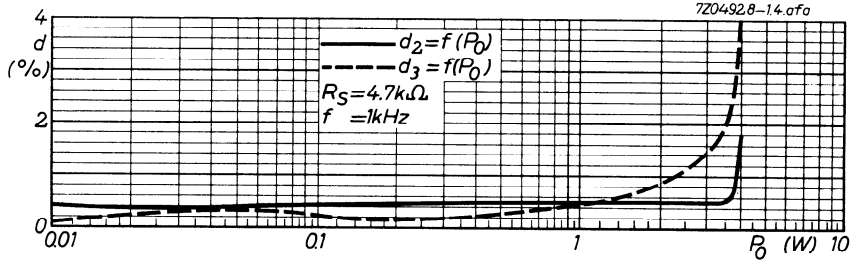
## APPLICATION INFORMATION

4 W transformerless audio frequency amplifier with matched pair AD161/AD162 in complementary symmetry class B output stage.




| | | |
|---|---|---|
| Typical input requirements for an output power of 4 W | $V_{i(rms)}$ = 28 mV; $I_{i(rms)}$ = 0.7 µA; | |
| | $R_i$ = 40 kΩ; $T_{amb}$ max. 45 °C | |
| Typical bandwidth (3 dB) | B = 70 Hz to 16 kHz | |
| Quiescent current | $I_{cq}$ = 8 mA, adjustable with $R_1$ | |
| Heatsink for AC132 | 10 $cm^2$ Al, thickness 1 mm | |
| Heatsinks for AD161 and AD162 | $R_{th\ h\text{-}a}$ < 14.5 °C/W | |
| Supply voltage | $-V_S$ = 24 V, max. 27 V | |

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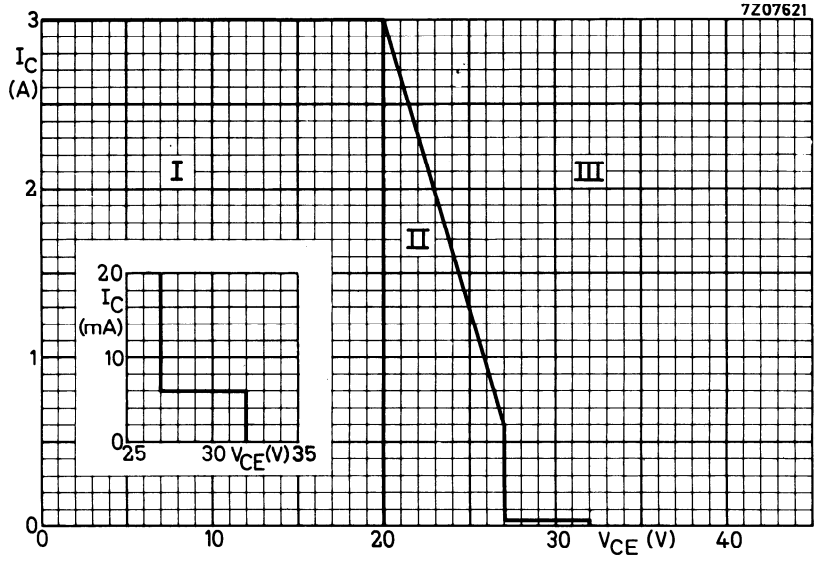


I = Region of permissible operation under all base-emitter conditions.

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 $-V_{BB} \leq 0.6$ V; $R_i = 18\ \Omega$.

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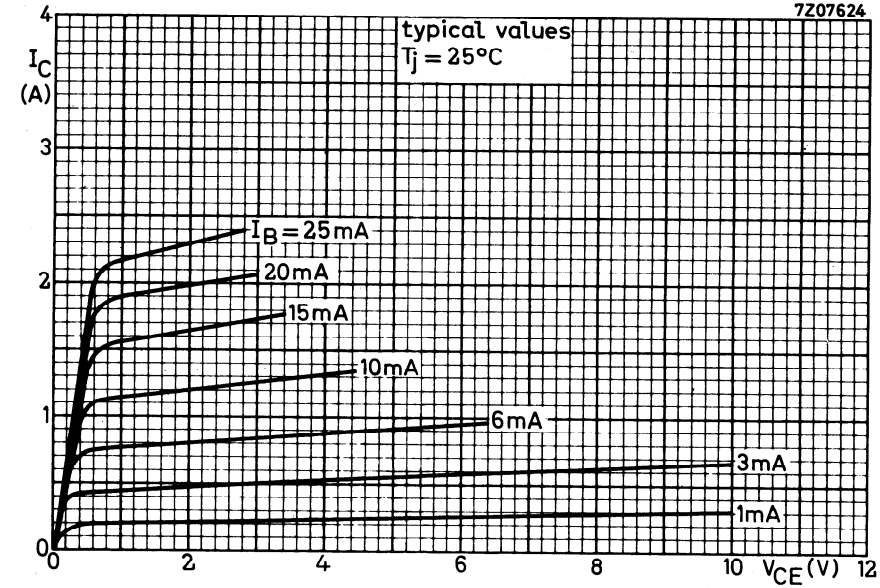
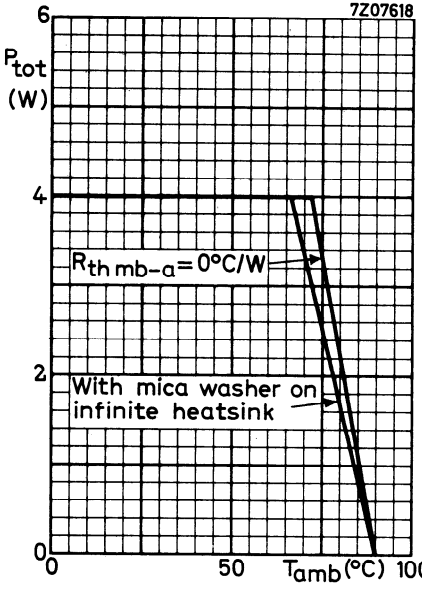
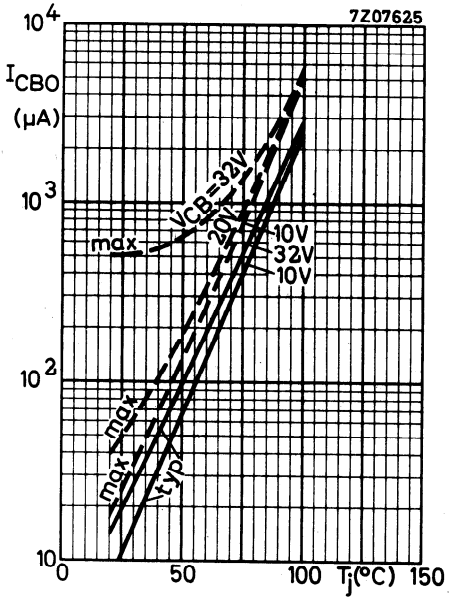
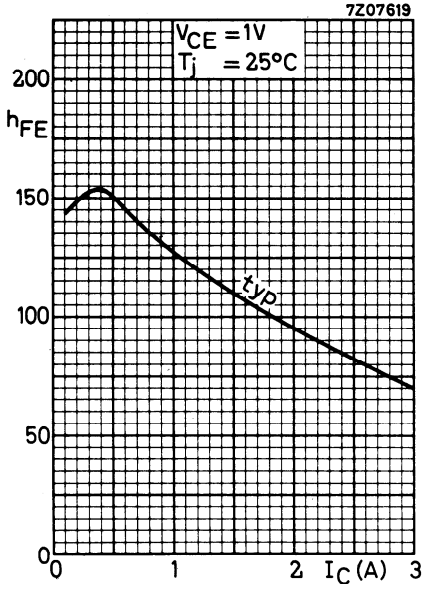
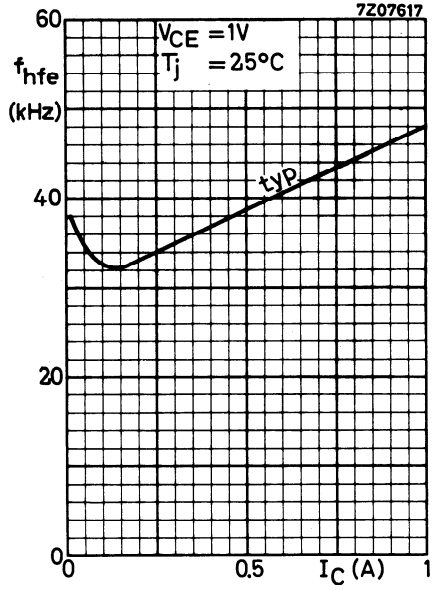
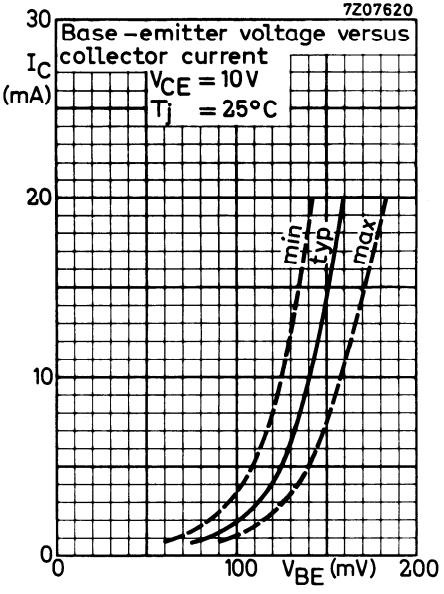

7Z07624
typical values
Tj = 25°C
IC (A)
IB = 25mA
20mA
15mA
10mA
6mA
3mA
1mA
VCE (V)

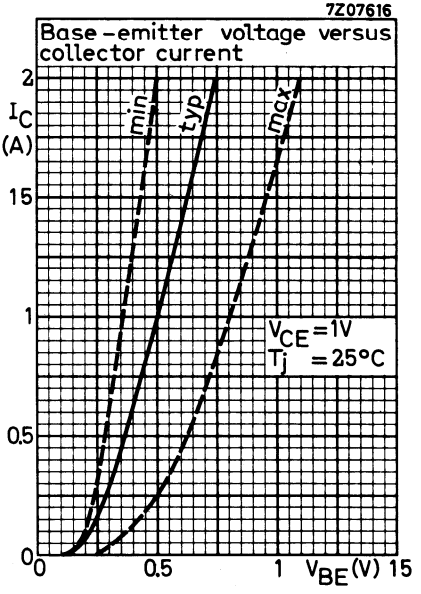

7Z07618
Ptot (W)
Rth mb-a = 0°C/W
With mica washer on infinite heatsink
Tamb (°C)

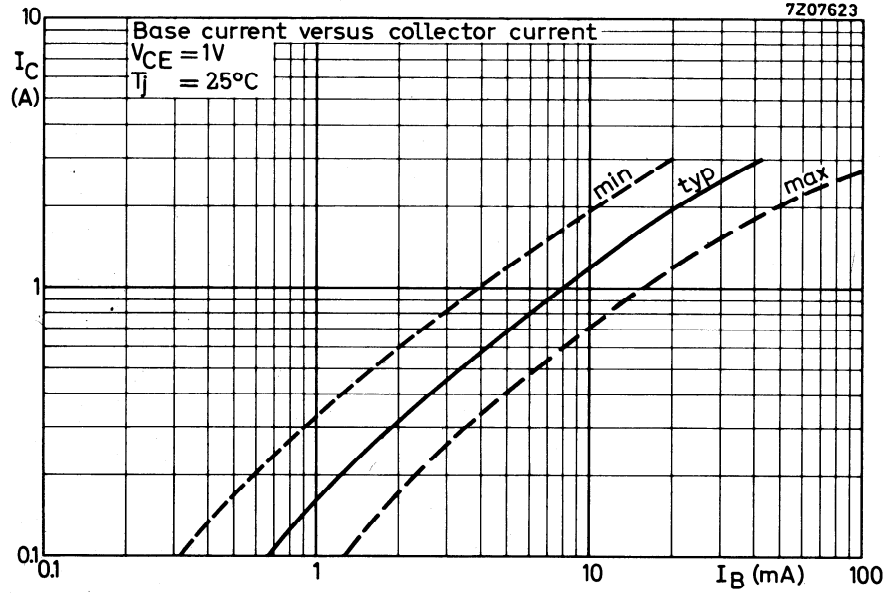

7Z07625
ICBO (μA)
max
VCB = 32V
20V
10V
32V
10V
max
max
typ
Tj (°C)

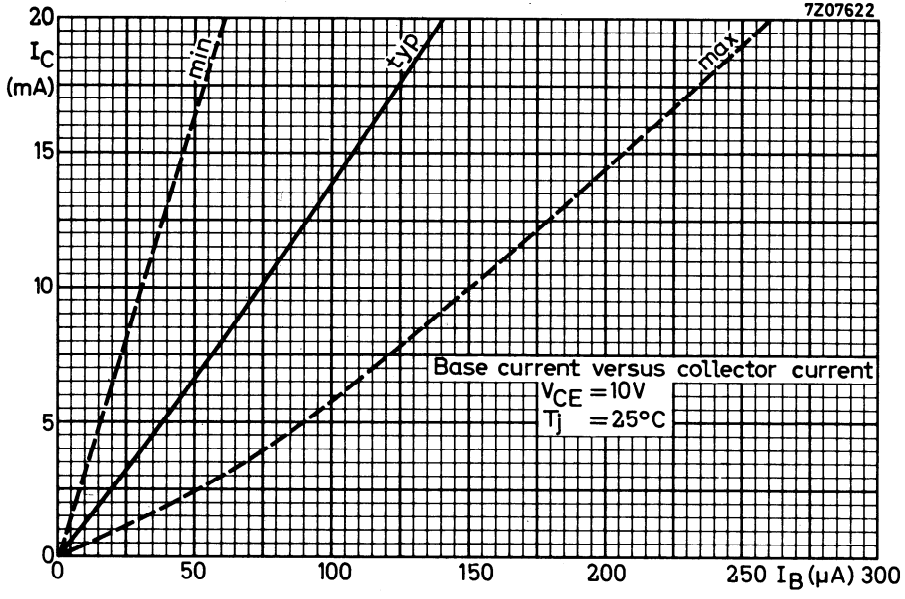

7Z07619
$V_{CE}$ = 1V
$T_j$ = 25°C
$h_{FE}$
200
150
100
50
0
typ
0
1
2
$I_C$ (A)
3


7Z07617
$V_{CE}$ = 1V
$T_j$ = 25°C
$f_{hfe}$
(kHz)
60
40
20
0
typ
0
0.5
$I_C$ (A)
1


7Z07620
Base-emitter voltage versus collector current
$V_{CE}$ = 10 V
$T_j$ = 25°C
$I_C$
(mA)
30
20
10
0
min
typ
max
0
100
$V_{BE}$ (mV)
200


7Z07616
Base-emitter voltage versus collector current
$I_C$
(A)
2
1.5
1
0.5
0
min
typ
max
$V_{CE}$ = 1V
$T_j$ = 25°C
0
0.5
1
$V_{BE}$ (V)
1.5


7Z07623
Base current versus collector current
$V_{CE}$ = 1V
$T_j$ = 25°C
$I_C$ (A)
10
1
0.1
0.1
1
10
100
$I_B$ (mA)
min
typ
max


7Z07622
$I_C$ (mA)
20
15
10
5
0
0
50
100
150
200
250
300
$I_B$ (μA)
min
typ
max
Base current versus collector current
$V_{CE}$ = 10V
$T_j$ = 25°C