Datablad

SILICON PLANAR EPITAXIAL TRANSISTORS

General purpose n-p-n transistors in a plastic TO-92 variant, especially suitable for use in driver stages of audio amplifiers.

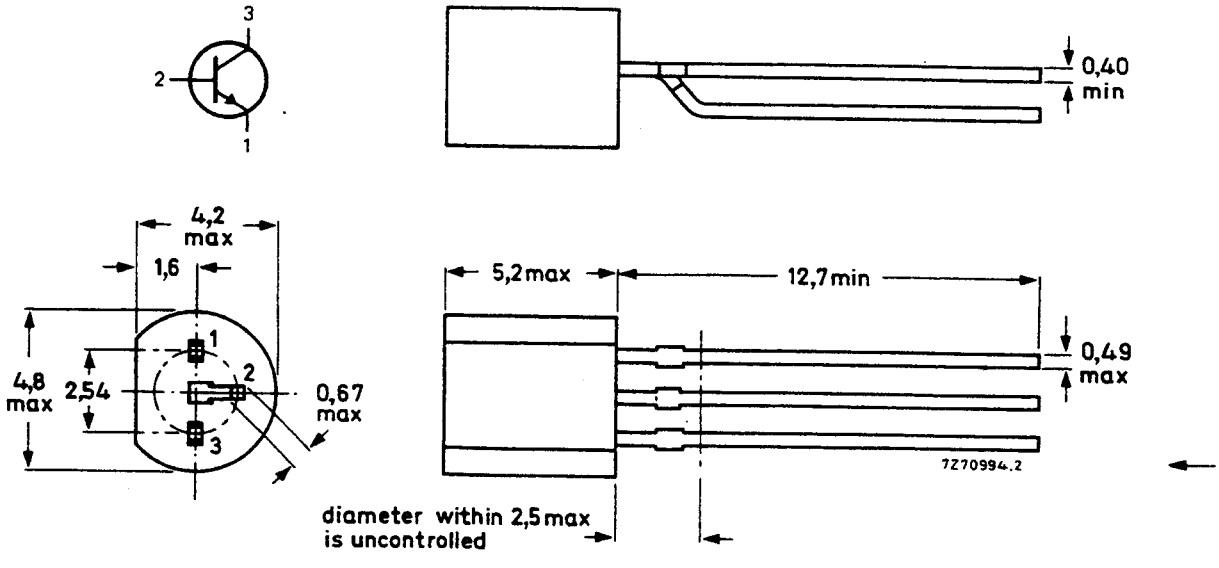
QUICK REFERENCE DATA

			BC546	BC547	BC548	
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	80	50	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	65	45	30	V
Collector current (peak value)	I_{CM}	max.	200	200	200	mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	500	500	500	mW
Junction temperature	T_j	max.	150	150	150	°C
Small-signal current gain I_C = 2 mA; V_{CE} = 5 V; f = 1 kHz	h_{fe}	>	125	125	125	
		<	500	900	900	
Transition frequency I_C = 10 mA; V_{CE} = 5 V	f_T	typ.	300	300	300	MHz
Noise figure at R_S = 2 kΩ I_C = 200 μA; V_{CE} = 5 V f = 1 kHz; B = 200 Hz	F	typ.	2	2	2	dB

MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92 variant.



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

			BC546	BC547	BC548	
Voltage						
Collector-base voltage (open emitter)	V_{CBO}	max.	80	50	30	V
Collector-emitter voltage (V_{BE} = 0)	V_{CES}	max.	80	50	30	V
Collector-emitter voltage (open base)	V_{CEO}	max.	65	45	30	V
Emitter-base voltage (open collector)	V_{EBO}	max.	6	6	5	V
Current						
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 °C	P_{tot}		max.		500	mW
Temperature						
Storage temperature	T_{stg}			−65 to +150		°C
Junction temperature	T_j		max.		150	°C
THERMAL RESISTANCE						
From junction to ambient in free air	$R_{th\ j\text{-}a}$		=		0,25	°C/mW
From junction to case	$R_{th\ j\text{-}c}$		=		0,15	°C/mW

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current

I_E = 0; V_{CB} = 30 V	I_{CBO}	<	15	nA
I_E = 0; V_{CB} = 30 V; T_j = 150 °C	I_{CBO}	<	5	μA

Base-emitter voltage [1]

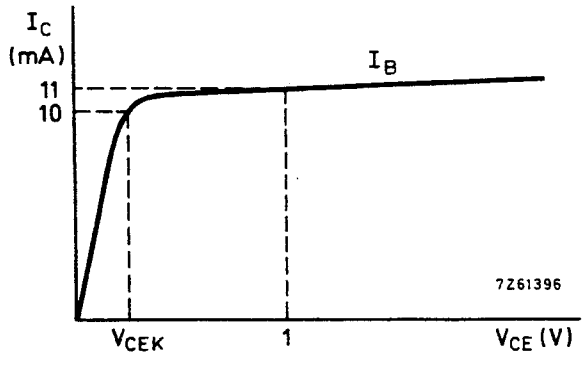
I_C = 2 mA; V_{CE} = 5 V	V_{BE}	typ.	660	mV
		580 to	700	mV
I_C = 10 mA; V_{CE} = 5 V	V_{BE}	<	770	mV

Saturation voltage [2]

I_C = 10 mA; I_B = 0.5 mA	V_{CEsat}	typ.	90	mV
		<	250	mV
	V_{BEsat}	typ.	700	mV
I_C = 100 mA; I_B = 5 mA	V_{CEsat}	typ.	200	mV
		<	600	mV
	V_{BEsat}	typ.	900	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
		<	600	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

$I_C = I_c$ = 0; V_{EB} = 0,5 V	C_e	typ.	9	pF

Transition frequency at f = 35 MHz

I_C = 10 mA; V_{CE} = 5 V	f_T	typ.	300	MHz

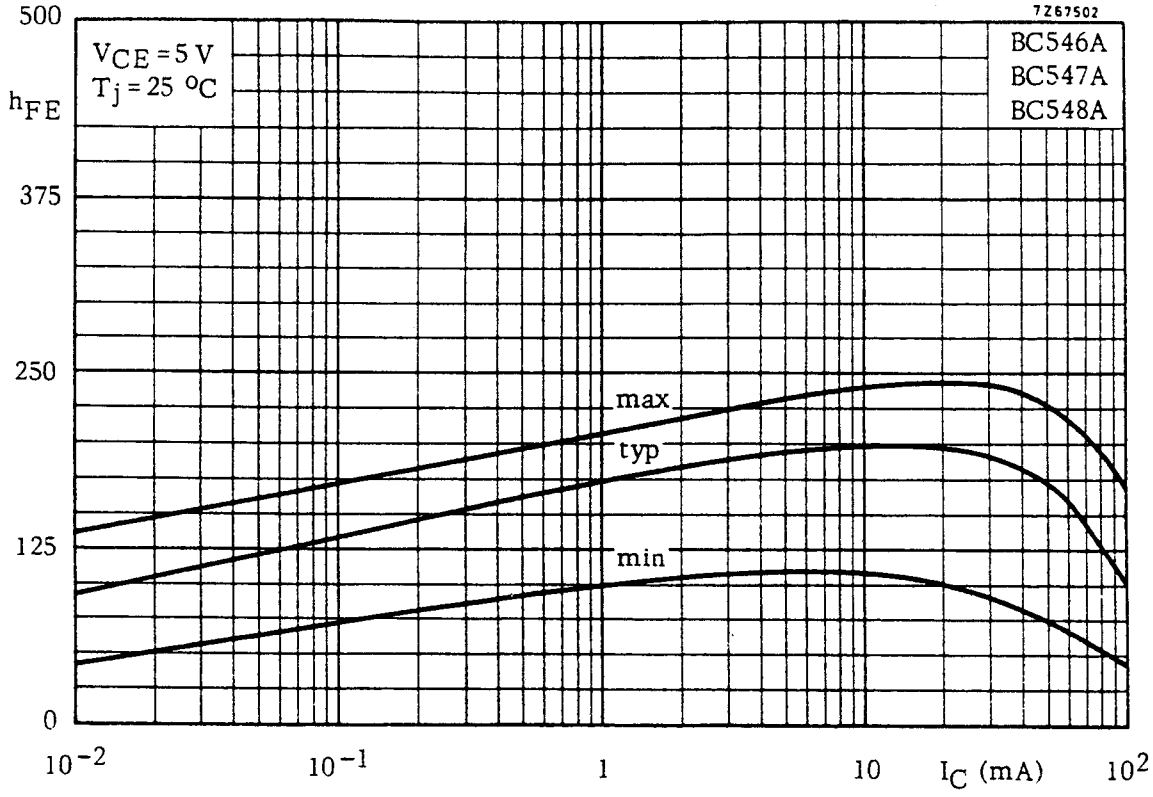
1) V_{BE} decreases by about 2 mV/°C with increasing temperature.
2) V_{BEsat} decreases by about 1,7 mV/°C with increasing temperature.

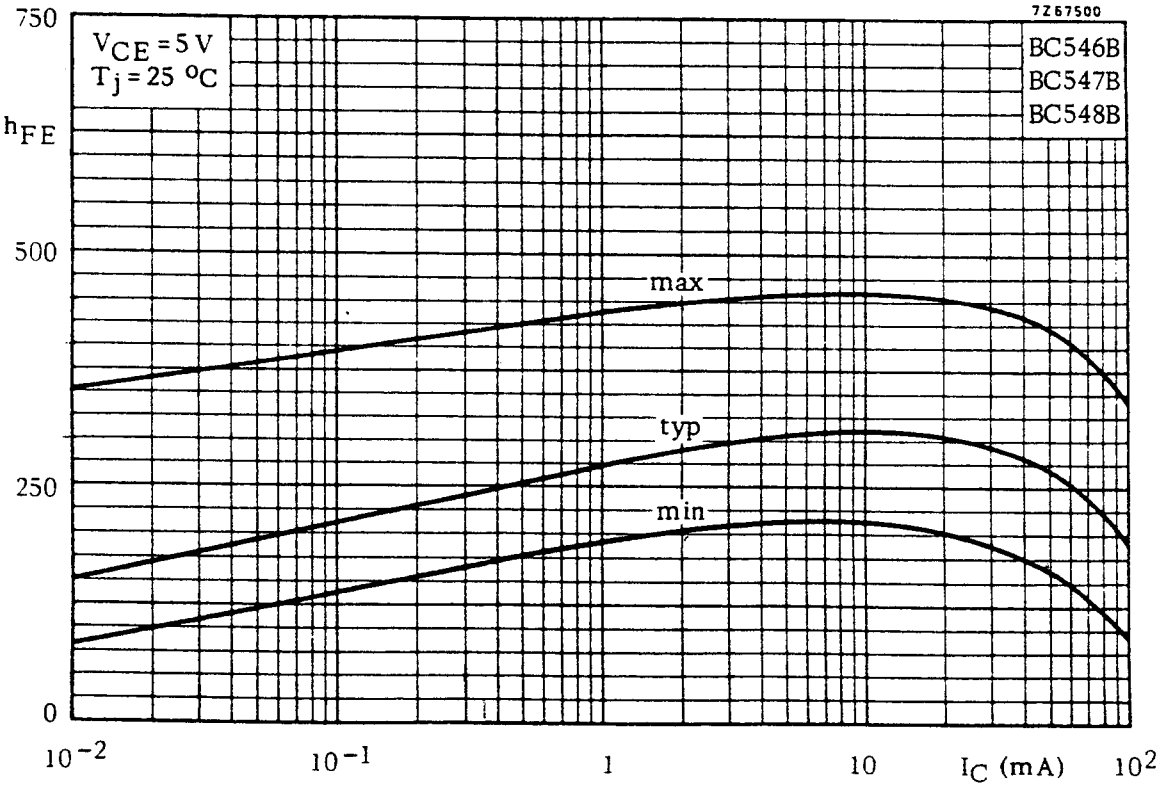
CHARACTERISTICS (continued)

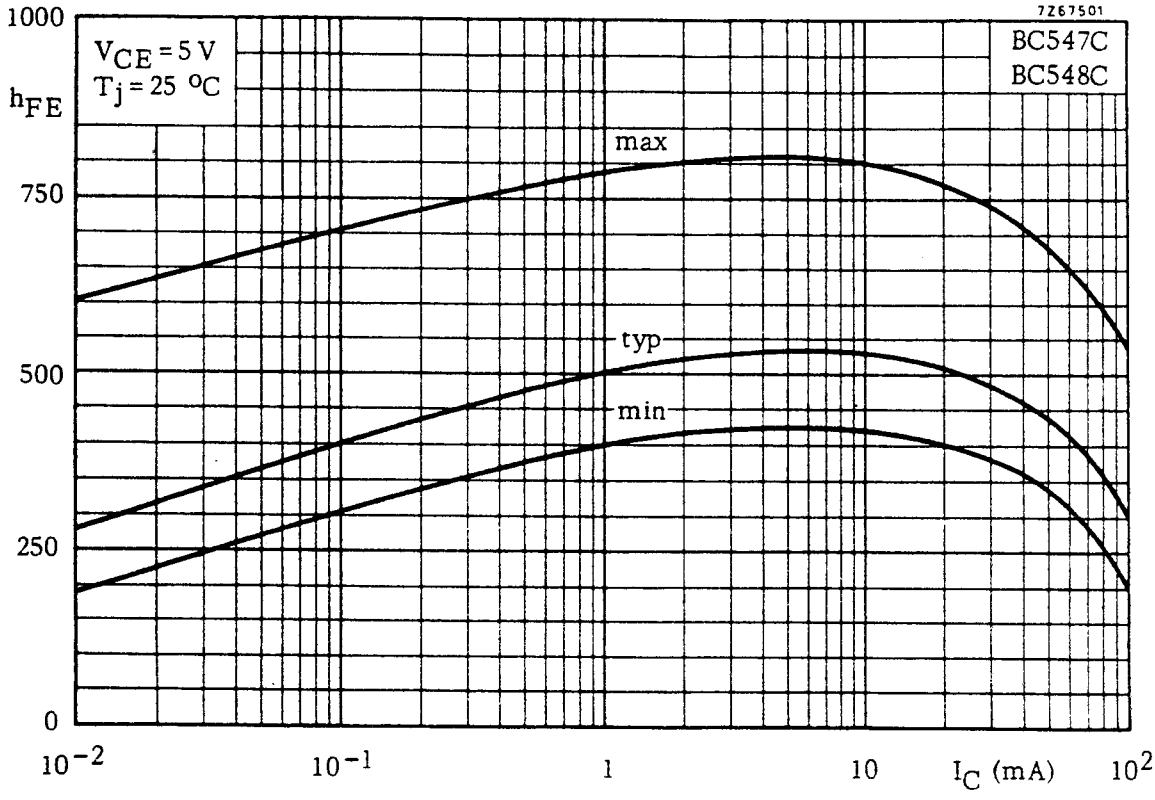
T_j = 25 °C unless otherwise specified

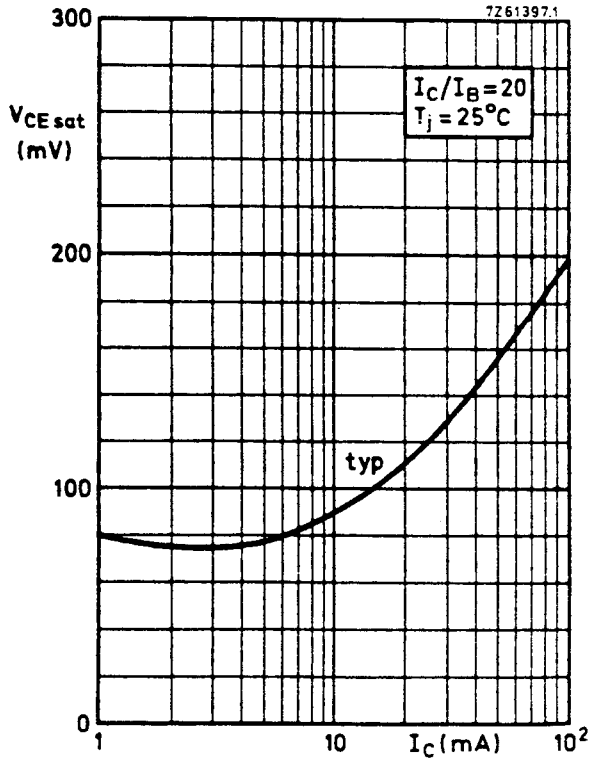
			BC546	BC547	BC548	
Small signal current gain at f = 1 kHz						
I_C = 2 mA; V_{CE} = 5 V	h_{fe}	>	125	125	125	
		<	500	900	900	
Noise figure at R_S = 2 kΩ						
I_C = 200 μA; V_{CE} = 5 V						
f = 1 kHz; B = 200 Hz	F	typ.	2	2	2	dB
		<	10	10	10	dB

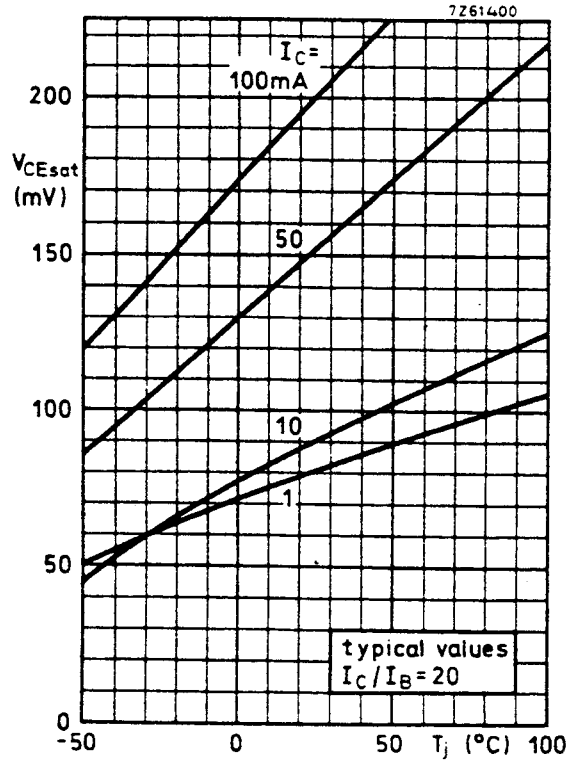
			BC546A BC547A BC548A	BC546B BC547B BC548B	BC547C BC548C
D.C. current gain					
I_C = 10 μA; V_{CE} = 5 V	h_{FE}	typ.	90	150	270
		>	110	200	420
I_C = 2 mA; V_{CE} = 5 V	h_{FE}	typ.	180	290	520
		<	220	450	800

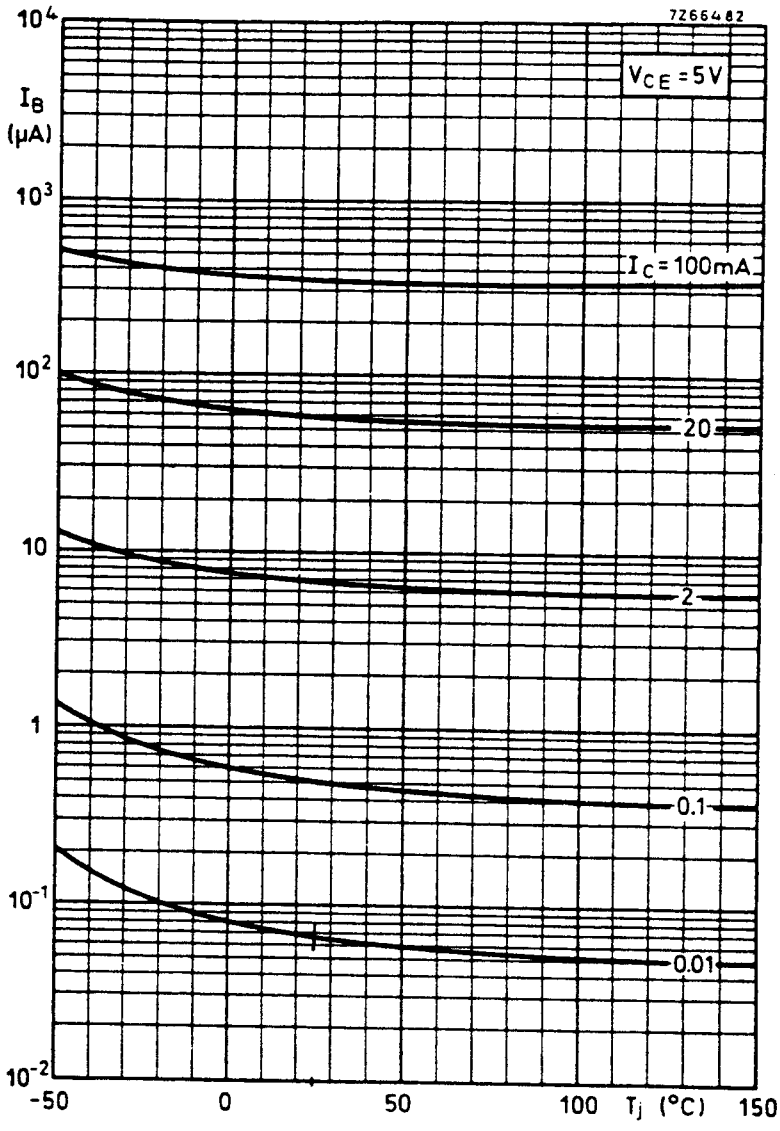

7Z67502
BC546A
BC547A
BC548A
V_{CE} = 5 V
T_j = 25 °C
h_{FE}
500
375
250
125
0
max
typ
min
10^{-2}
10^{-1}
1
10
I_C (mA)
10^2


7Z67500
BC546B
BC547B
BC548B
V_{CE} = 5 V
T_j = 25 °C
h_{FE}
750
500
250
0
max
typ
min
10^{-2}
10^{-1}
1
10
I_C (mA)
10^2

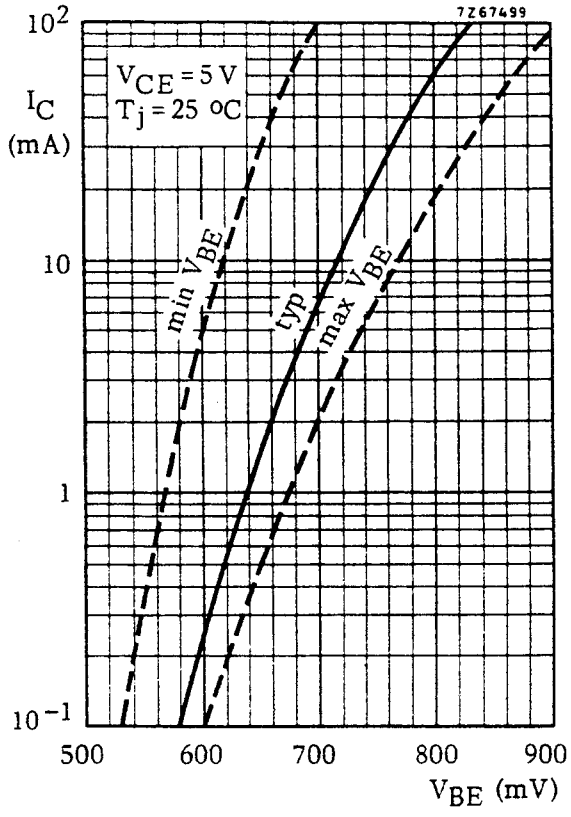

7Z67501
1000
h_{FE}
750
500
250
0
V_{CE} = 5 V
T_j = 25 °C
BC547C
BC548C
max
typ
min
10^{-2}
10^{-1}
1
10
I_C (mA)
10^2

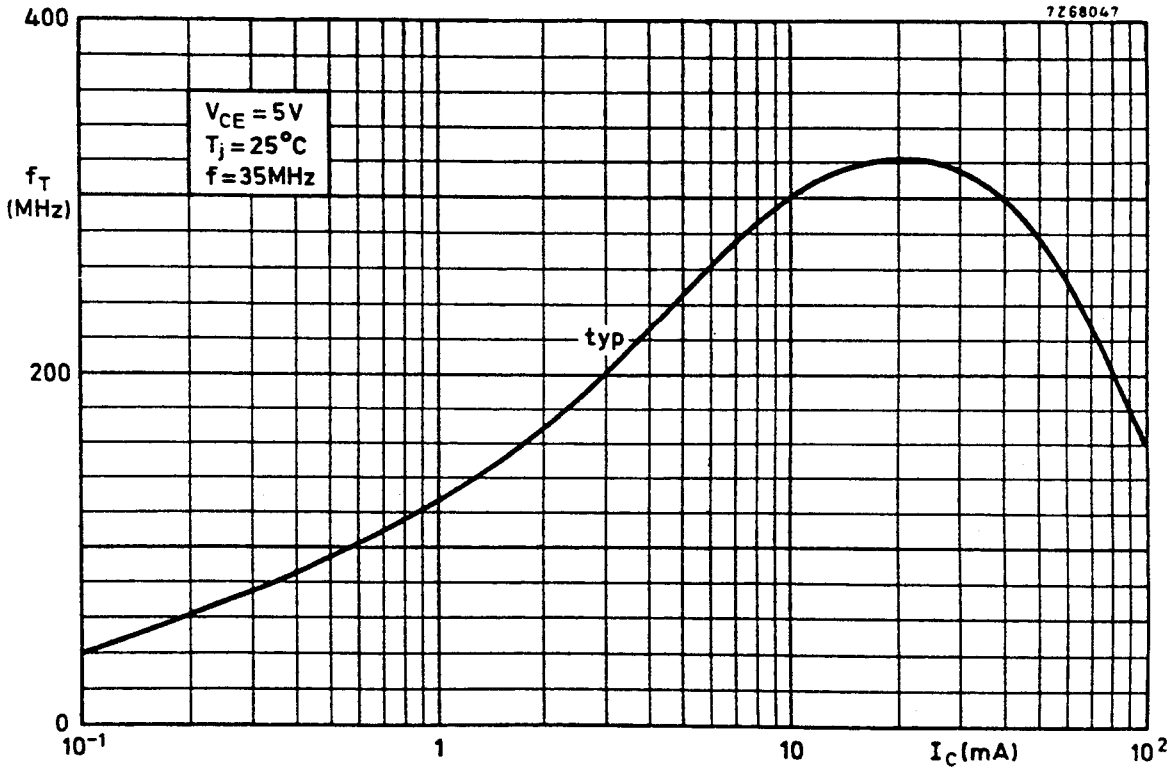

7Z61397.1
300
$V_{CE\,sat}$ (mV)
200
100
0
I_C/I_B = 20
T_j = 25°C
typ
1
10
I_C (mA)
10^2

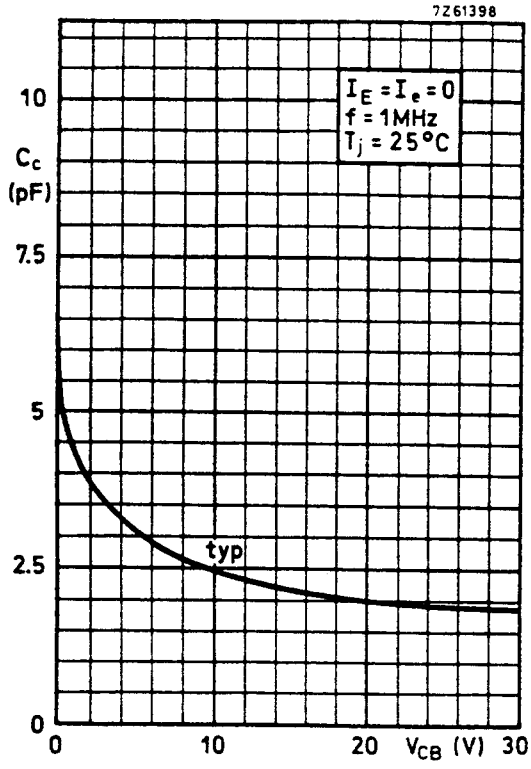

7Z61400
200
V_{CEsat} (mV)
150
100
50
0
I_C = 100mA
50
10
1
typical values
I_C/I_B = 20
-50
0
50
T_j (°C)
100

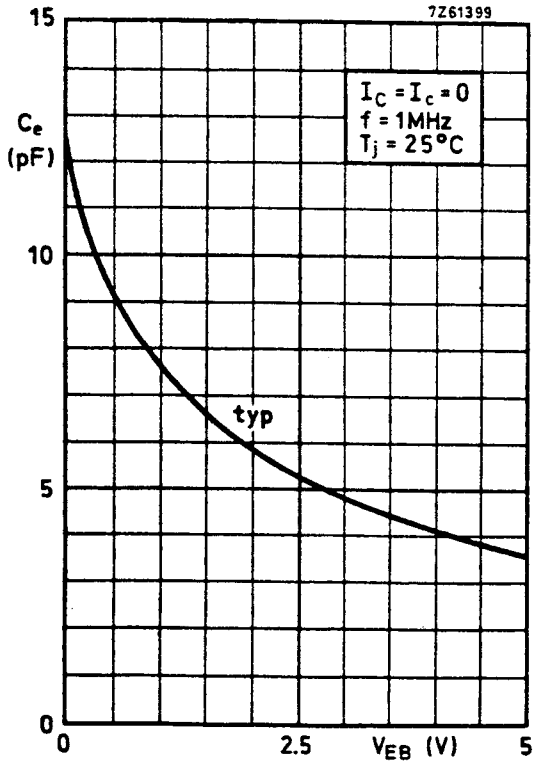


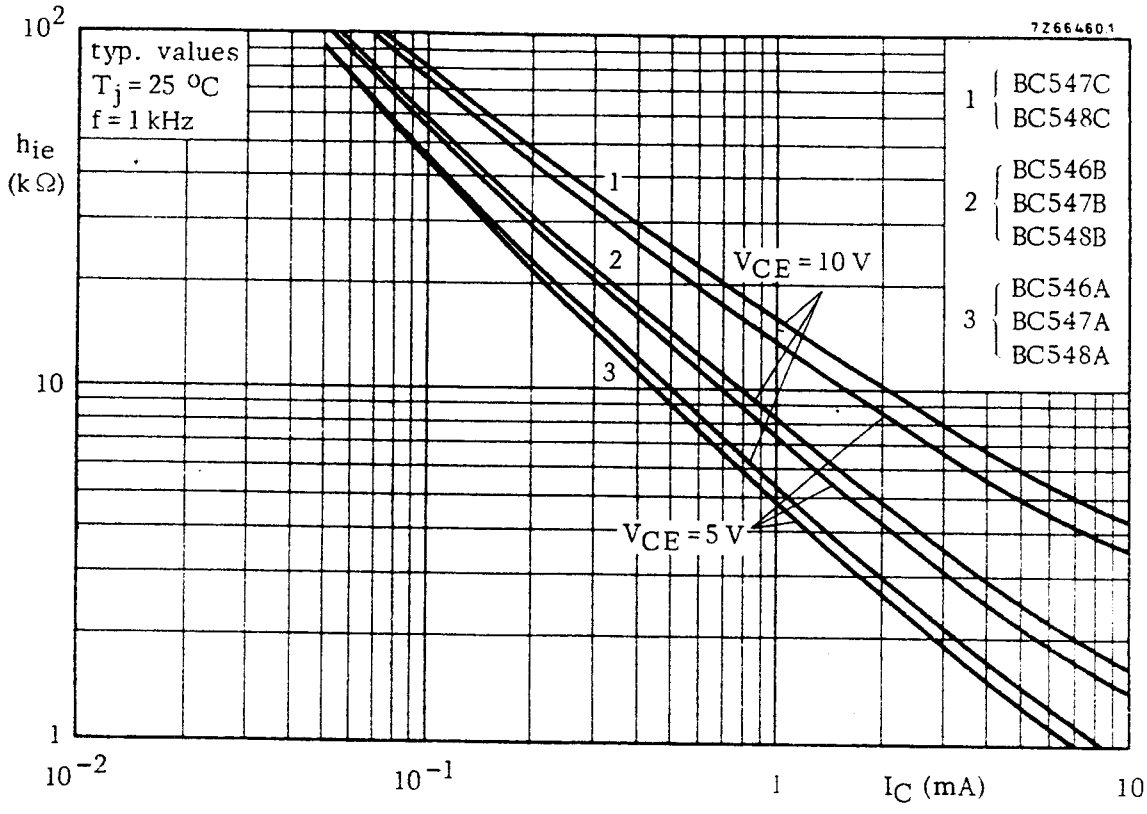
Typical behaviour of base current versus junction temperature

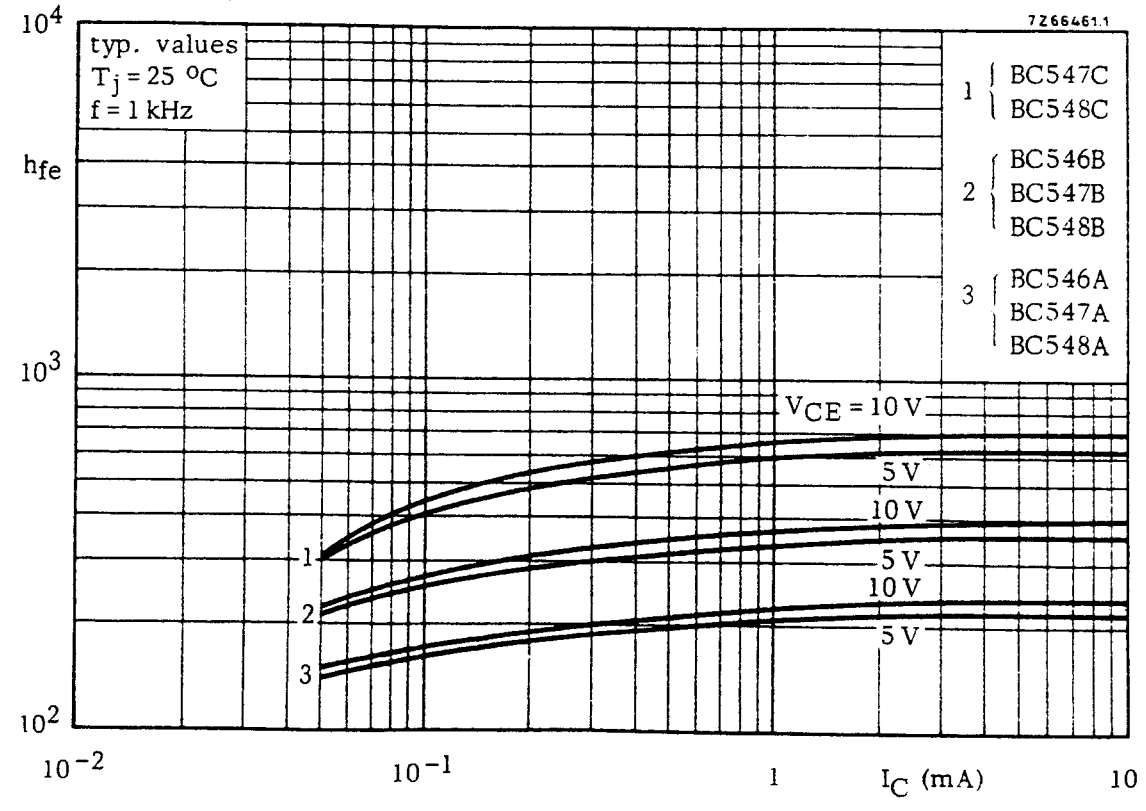

7Z67499
10^2
I_C
(mA)
10
1
10^{-1}
V_{CE} = 5 V
T_j = 25 °C
min V_{BE}
typ
max V_{BE}
500
600
700
800
900
V_{BE} (mV)

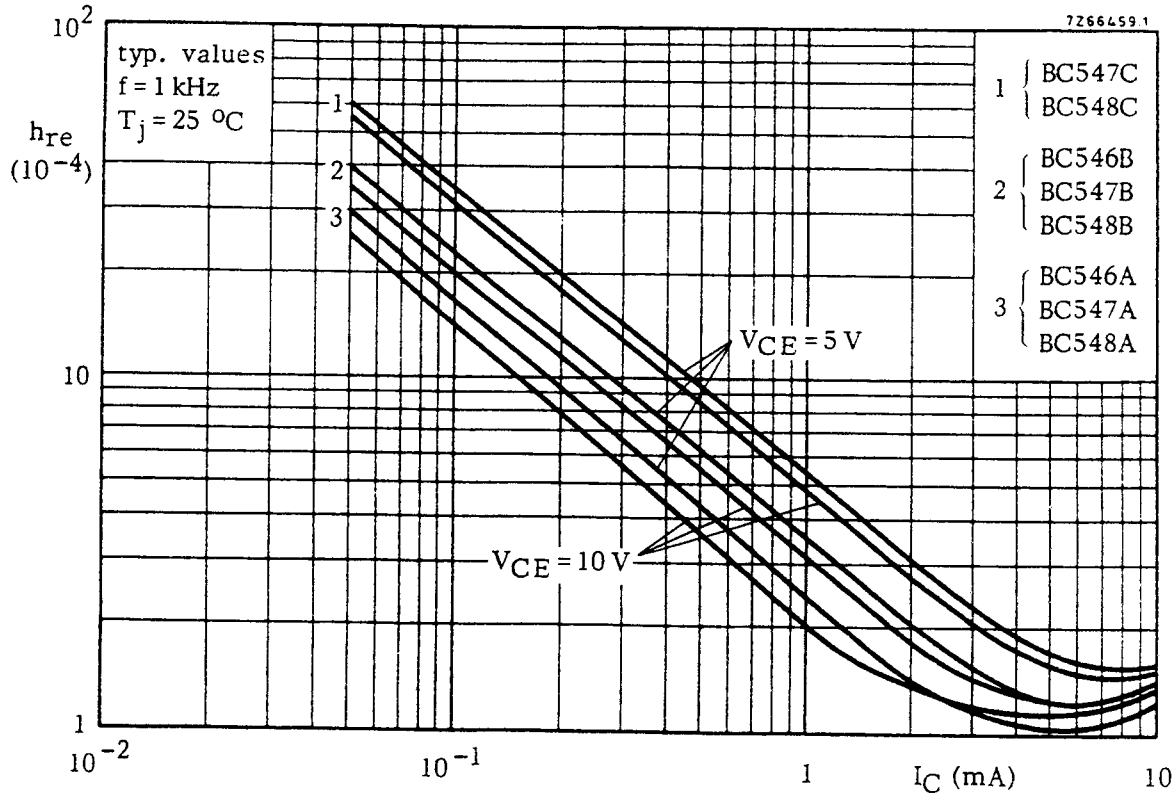

7Z68047
400
f_T
(MHz)
200
0
V_{CE} = 5V
T_j = 25°C
f = 35MHz
typ
10^{-1}
1
10
I_C(mA)
10^2

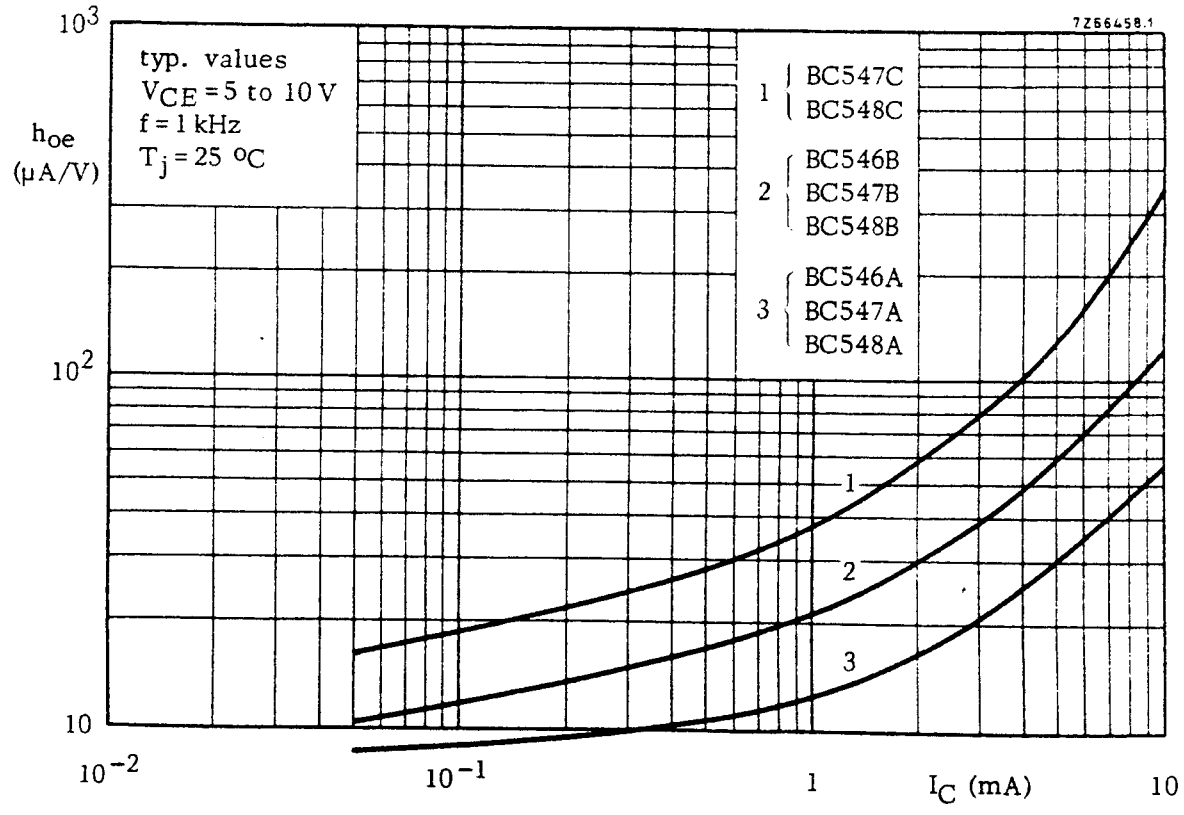

7Z61398
$I_E = I_e = 0$
f = 1MHz
T_j = 25°C
C_c (pF)
10
7.5
5
2.5
0
typ
0
10
20
V_{CB} (V)
30


7Z61399
$I_C = I_c = 0$
f = 1MHz
T_j = 25°C
C_e (pF)
15
10
5
0
typ
0
2.5
V_{EB} (V)
5


7Z66460.1
typ. values
T_j = 25 °C
f = 1 kHz
h_{ie} (kΩ)
10^2
10
1
10^{-2}
10^{-1}
1
10
I_C (mA)
1 BC547C BC548C
2 BC546B BC547B BC548B
3 BC546A BC547A BC548A
V_{CE} = 10 V
V_{CE} = 5 V


7Z66461.1
typ. values
T_j = 25 °C
f = 1 kHz
h_{fe}
10^4
10^3
10^2
10^{-2}
10^{-1}
1
10
I_C (mA)
1 BC547C BC548C
2 BC546B BC547B BC548B
3 BC546A BC547A BC548A
V_{CE} = 10 V
5 V
10 V
5 V
10 V
5 V


7Z66459.1
typ. values
f = 1 kHz
T_j = 25 °C
h_{re} (10^{-4})
10^2
10
1
10^{-2}
10^{-1}
1
10
I_C (mA)
1
2
3
V_{CE} = 5 V
V_{CE} = 10 V
1 BC547C BC548C
2 BC546B BC547B BC548B
3 BC546A BC547A BC548A


7Z66458.1
typ. values
V_{CE} = 5 to 10 V
f = 1 kHz
T_j = 25 °C
h_{oe} (μA/V)
10^3
10^2
10
10^{-2}
10^{-1}
1
10
I_C (mA)
1
2
3
1 BC547C BC548C
2 BC546B BC547B BC548B
3 BC546A BC547A BC548A

N-CHANNEL ENHANCEMENT MODE VERTICAL D-MOS TRANSISTOR

N-channel enhancement mode vertical D-MOS transistor in TO-92 variant envelope and intended for use in relay, high-speed and line-transformer drivers.

Features

- Low R_{DSon}.
- Direct interface to C-MOS, TTL, etc.
- High-speed switching.
- No secondary breakdown.

QUICK REFERENCE DATA

Drain-source voltage	V_{DS}	max.	60 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	15 V
Drain current (DC)	I_D	max.	500 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	830 mW
Junction temperature	T_j	max.	150 °C
Drain-source ON-resistance V_{GS} = 10 V; I_D = 200 mA	R_{DSon}	max.	5 Ω

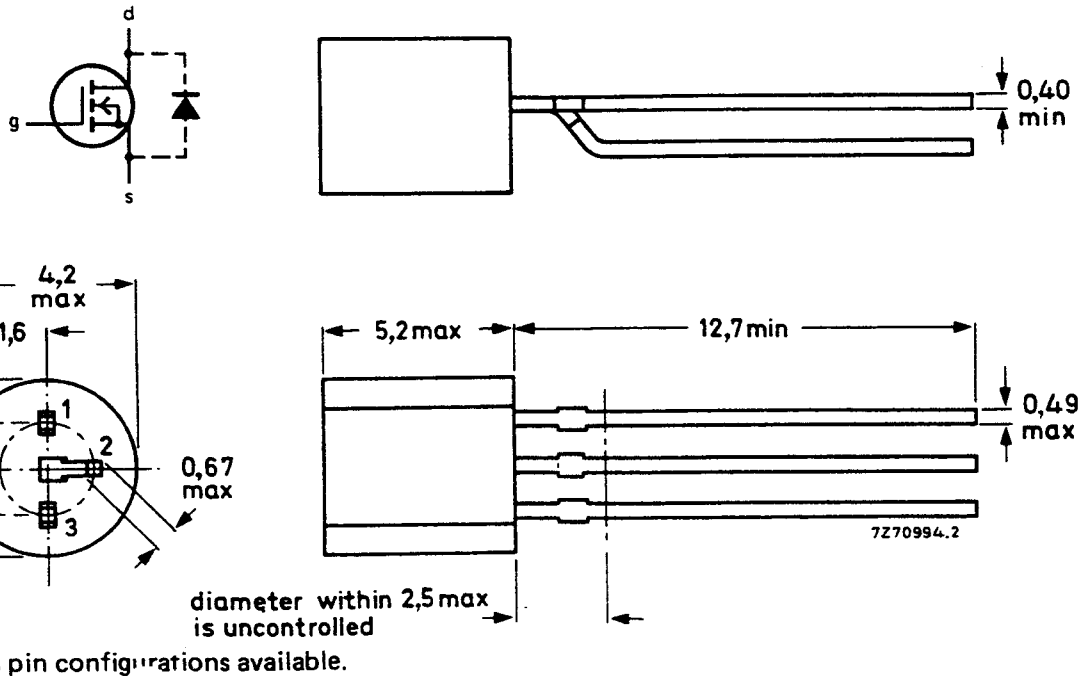
MECHANICAL DATA

Dimensions in mm

Fig. 1 TO-92 variant.

Pinning:

1 = source
2 = gate
3 = drain



Note: Various pin configurations available.

RATINGS

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

Drain-source voltage	V_{DS}	max.	60 V
Drain-gate voltage	V_{DG}	max.	60 V
Gate-source voltage (open drain)	$\pm V_{GSO}$	max.	15 V
Drain current (DC) at T_c = 25 °C	I_D	max.	500 mA
Total power dissipation up to T_{amb} = 25 °C	P_{tot}	max.	830 mW
Storage temperature range	T_{stg}		−55 to +150 °C
Junction temperature	T_j	max.	150 °C

THERMAL RESISTANCE

From junction to ambient	$R_{th\ j\text{-}a}$	=	150 K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Drain-source breakdown voltage V_{GS} = 0; I_D = 100 μA	$V_{(BR)DSS}$	min. typ.	60 V 90 V
Gate threshold voltage V_{GS} = V_{DS}; I_D = 1 mA	$V_{GS(th)}$	min. max.	0.8 V 3.0 V
Gate-source leakage current V_{GS} = 15 V; V_{DS} = 0	I_{GSoff}	max.	10 nA
Drain cut-off current V_{DS} = 25 V; V_{GS} = 0	I_{DSS}	max.	0.5 μA
Drain-source ON-resistance V_{GS} = 10 V; I_D = 200 mA	R_{DSon}	typ. max.	2.5 Ω 5.0 Ω
Transfer admittance V_{DS} = 10 V; I_D = 200 mA;	$\lvert Y_{fs} \rvert$	typ.	200 mS
Capacitances at f = 1 MHz V_{DS} = 10 V; V_{GS} = 0	C_{iss}	typ. max.	25 pF 40 pF
	C_{oss}	typ. max.	22 pF 30 pF
	C_{rss}	typ. max.	6 pF 10 pF
Switching times at I_D = 200 mA I_D = 200 mA; V_{DD} = 50 V;	t_{on}	typ. max.	4 ns 10 ns
V_{GS} = 0 to 10 V	t_{off}	typ. max.	4 ns 10 ns

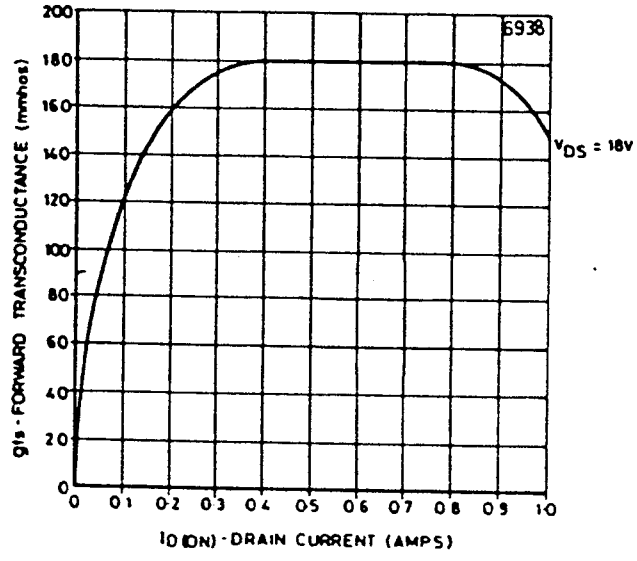


Fig. 5 Typical transconductance v drain current

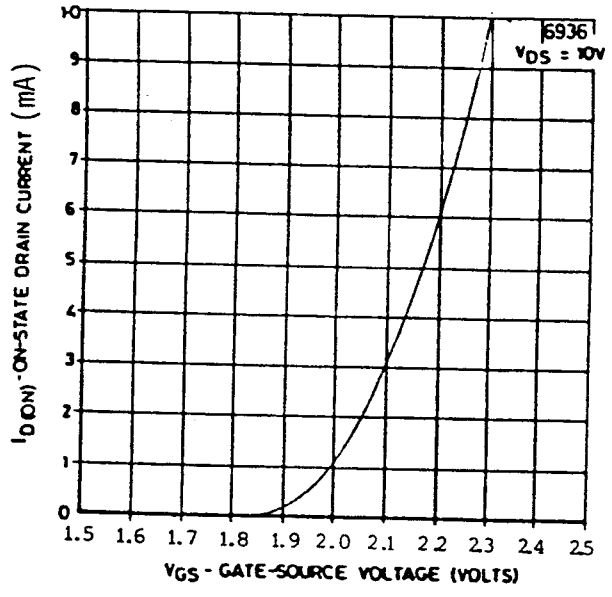


Fig. 6 Typical transfer characteristics

SILICON PLANAR EPITAXIAL POWER TRANSISTORS

General purpose n-p-n transistors in SOT-32 plastic envelope, recommended for driver stages in hi-fi amplifiers and television circuits.
The BD136, BD138 and BD140 are complementary to the BD135, BD137 and BD139 respectively.

QUICK REFERENCE DATA

			BD135	BD137	BD139	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Collector current (d.c.)	I_C	max.	1,5	1,5	1,5	A
Collector current (peak value)	I_{CM}	max.	2,0	2,0	2,0	A
Total power dissipation up to T_{mb} = 70 °C	P_{tot}	max.	8	8	8	W
Junction temperature	T_j	max.	150	150	150	°C
D.C. current gain I_C = 150 mA; V_{CE} = 2 V	h_{FE}	> <	40 250	40 250	40 250	
Transition frequency I_C = 50 mA; V_{CE} = 5 V	f_T	typ.	250	250	250	MHz

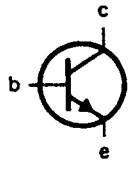
MECHANICAL DATA

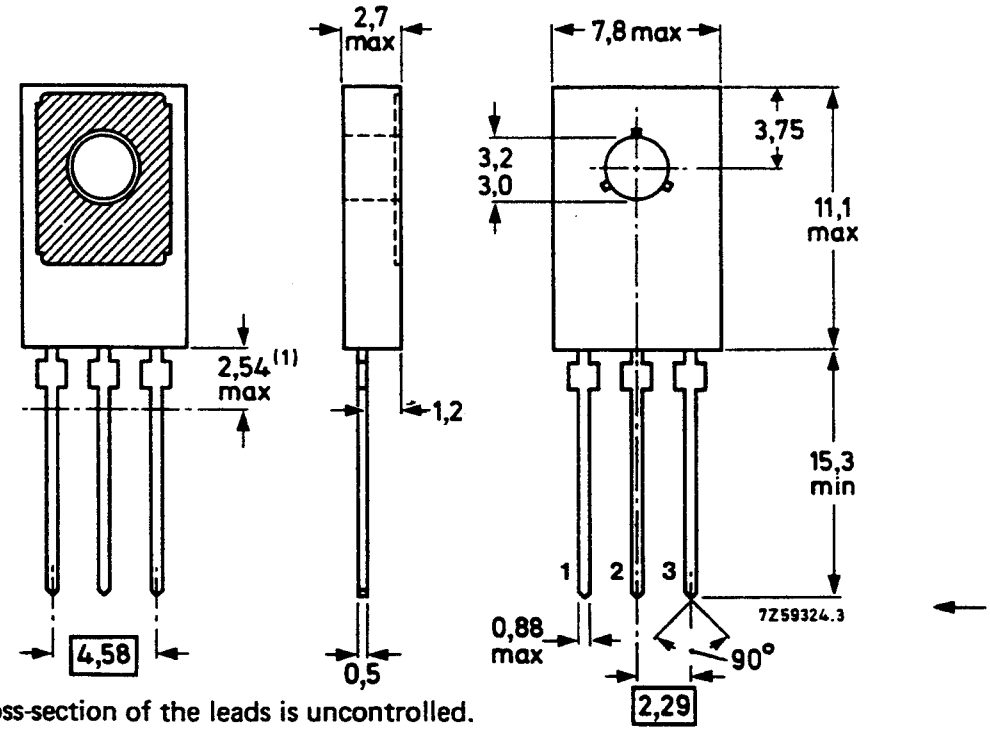
Dimensions in mm

Fig. 1 TO-126 (SOT-32).

Collector connected to metal part of mounting surface.

Pinning
1 = emitter
2 = collector
3 = base





(1) Within this region the cross-section of the leads is uncontrolled.

See also chapters Mounting instructions and Accessories.

RATINGS

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

			BD135	BD137	BD139	
Collector-base voltage (open emitter)	V_{CBO}	max.	45	60	100	V
Collector-emitter voltage (open base)	V_{CEO}	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	V_{CER}	max.	45	60	100	V
Emitter-base voltage (open collector)	V_{EBO}	max.	5	5	5	V
Collector current (d.c.)	I_C	max.	1,5	1,5	1,5	A
Collector current (peak value)	I_{CM}	max.	2,0	2,0	2,0	A
Total power dissipation up to T_{mb} = 70 °C	P_{tot}	max.			8	W
Storage temperature	T_{stg}			−65 to +150		°C
Junction temperature	T_j	max.			150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	100	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	10	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; V_{CB} = 30 V	I_{CBO}	<	100	nA
I_E = 0; V_{CB} = 30 V; T_j = 125 °C	I_{CBO}	<	10	μA
Emitter cut-off current				
I_C = 0; V_{EB} = 5 V	I_{EBO}	<	10	μA
Base-emitter voltage				
I_C = 500 mA; V_{CE} = 2 V	V_{BE}	<	1	V
Saturation voltage				
I_C = 500 mA; I_B = 50 mA	V_{CEsat}	<	0,5	V
D.C. current gain				
I_C = 5 mA; V_{CE} = 2 V	h_{FE}	>	25	
I_C = 150 mA; V_{CE} = 2 V				
BDxxx	h_{FE}		40 to 250	
BDxxx-6	h_{FE}		40 to 100	
BDxxx-10	h_{FE}		63 to 160	
BDxxx-16	h_{FE}		100 to 250	
I_C = 500 mA; V_{CE} = 2 V	h_{FE}	>	25	
Transition frequency at f = 35 MHz				
I_C = 50 mA; V_{CE} = 5 V	f_T	typ.	250	MHz
D.C. current gain ratio of matched pairs				
BD135/BD136; BD137/BD138; BD139/BD140				
$\|I_C\|$ = 150 mA; $\|V_{CE}\|$ = 2 V	h_{FE1}/h_{FE2}	typ.	1,3	
		<	1,6	

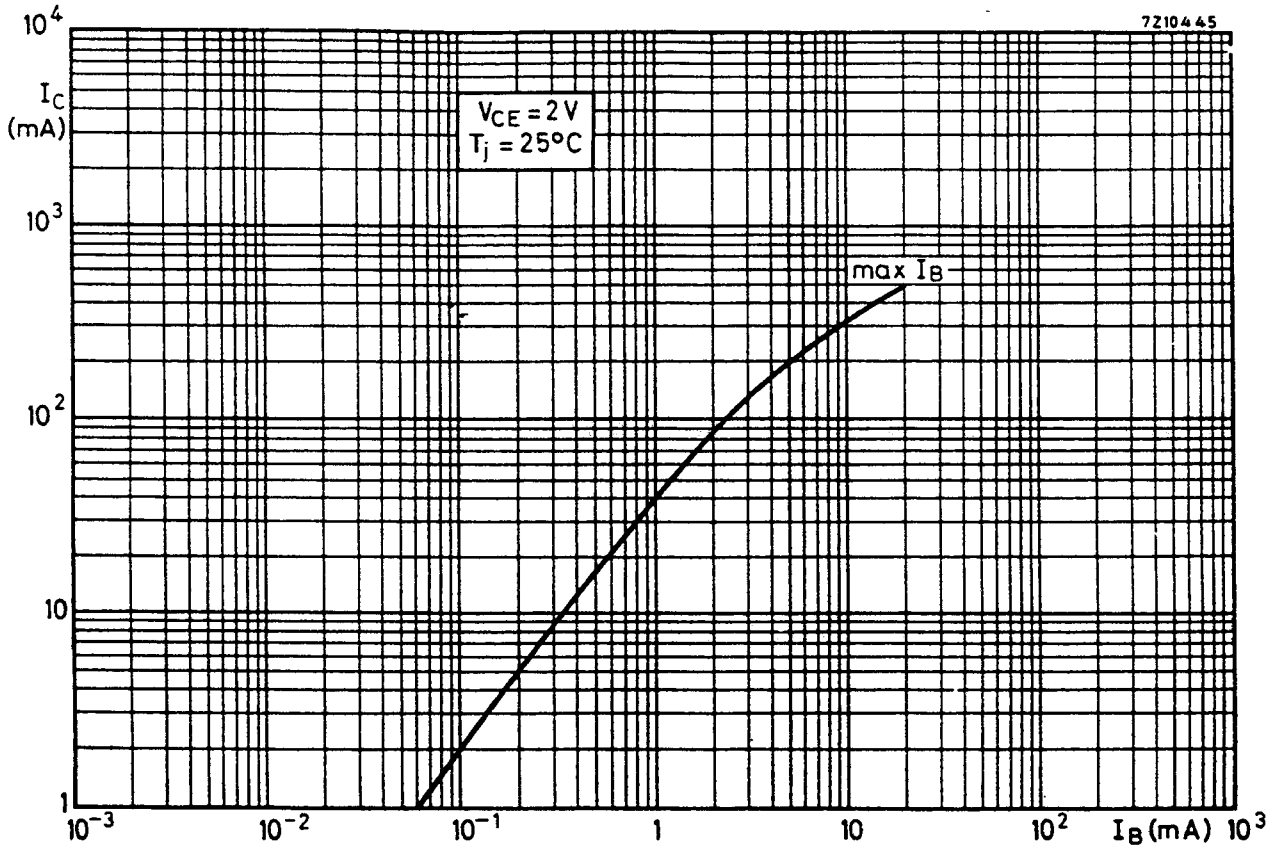

7Z10445
10^4
I_C
(mA)
10^3
10^2
10
1
$V_{CE} = 2V$
$T_j = 25°C$
max I_B
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
I_B (mA)
10^3

Fig. 10.

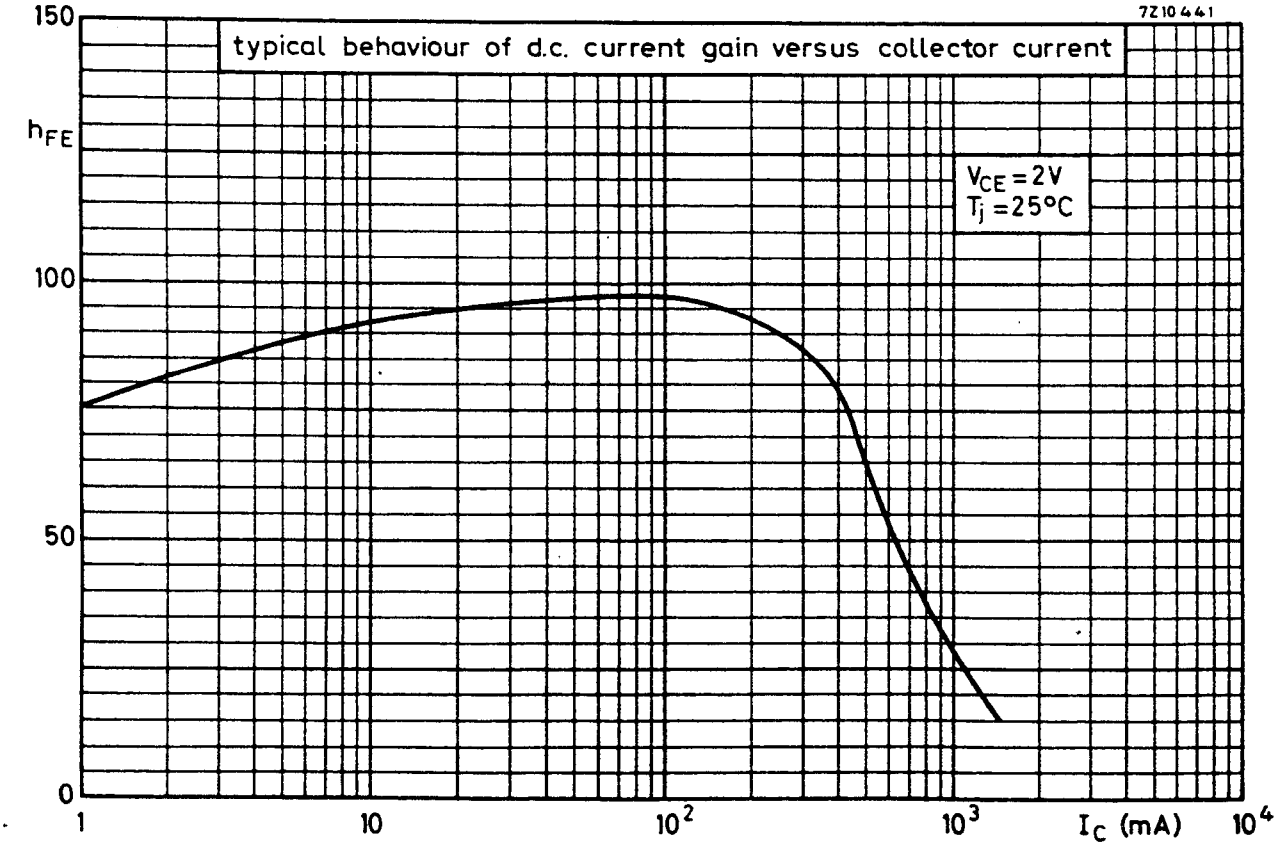

7Z10441
typical behaviour of d.c. current gain versus collector current
150
h_{FE}
100
50
0
$V_{CE} = 2V$
$T_j = 25°C$
1
10
10^2
10^3
I_C (mA)
10^4

Fig. 11.

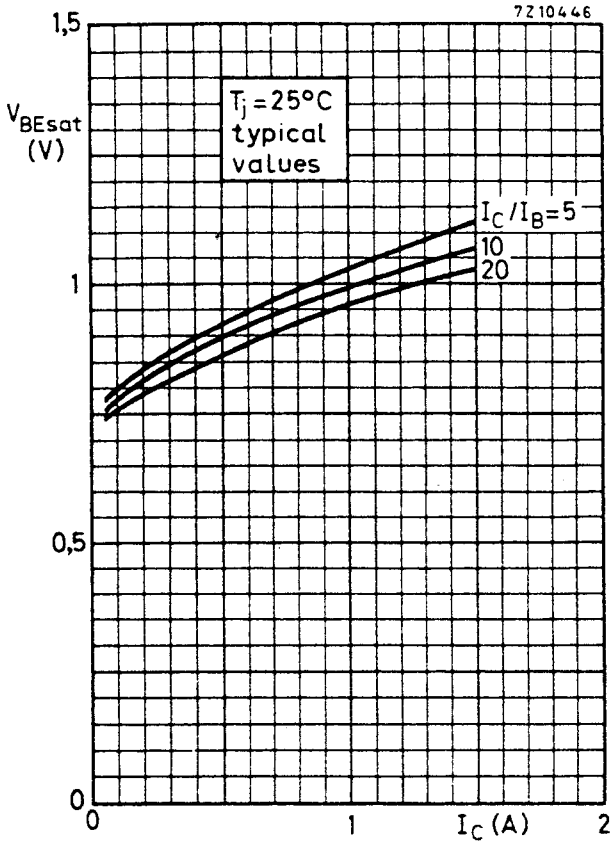


Fig. 12.

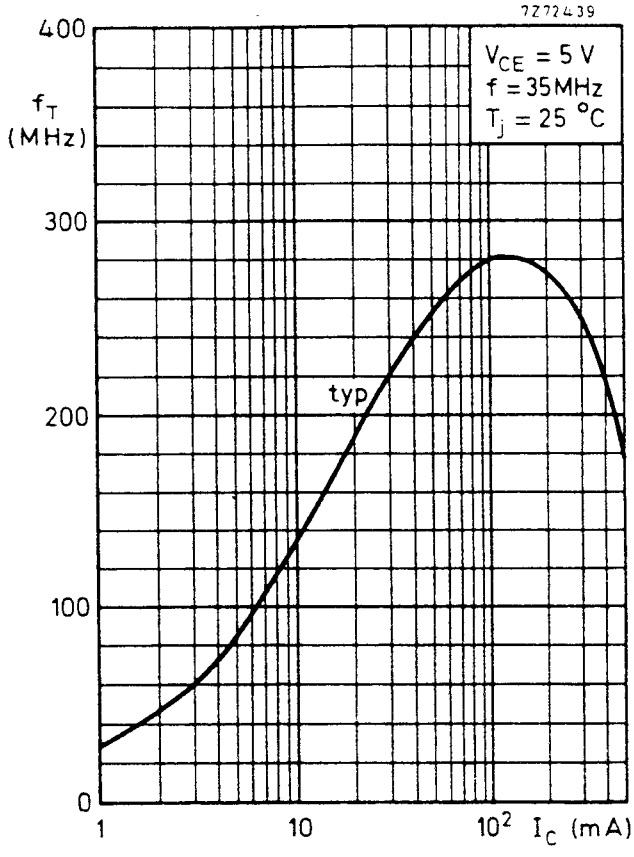


Fig. 13.

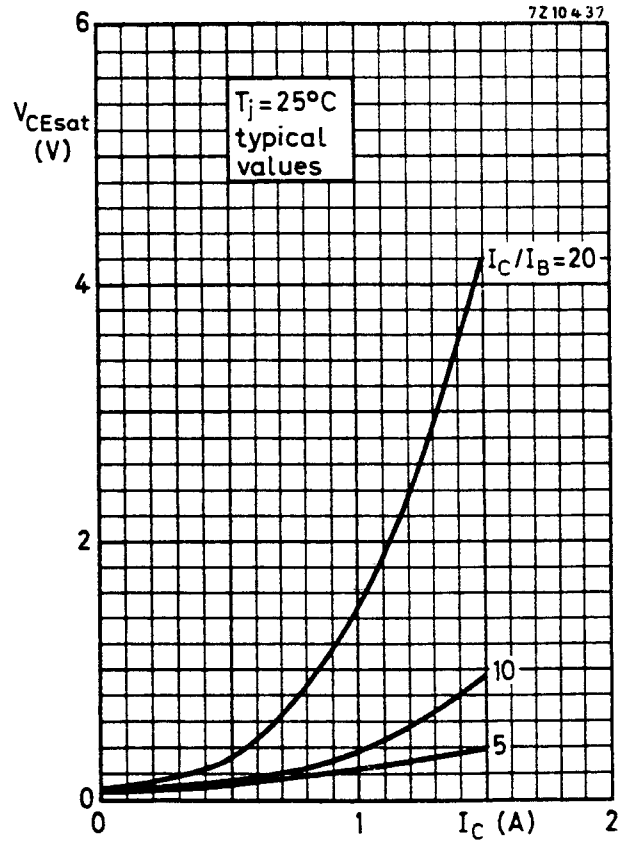


Fig. 14.

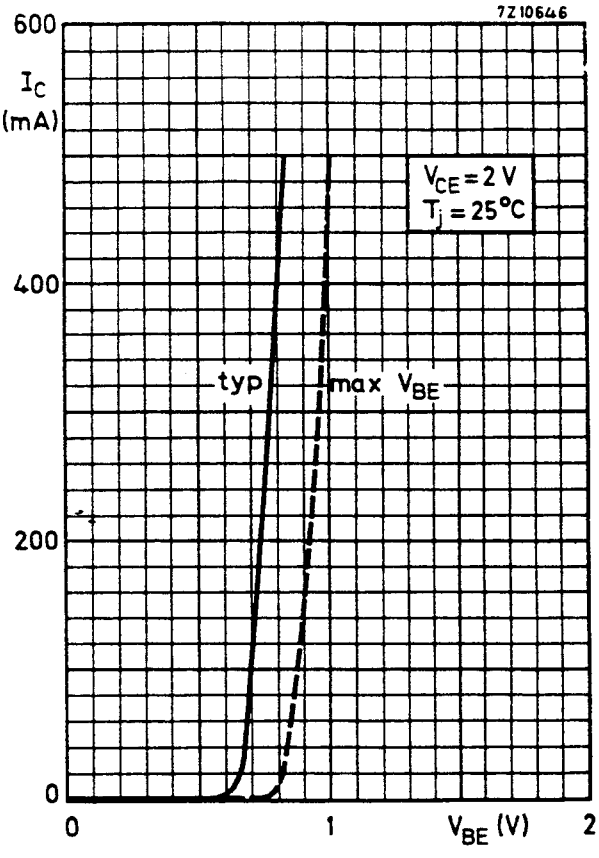


Fig. 15.

SILICON PLANAR EPITAXIAL POWER TRANSISTORS

General purpose p-n-p transistors in SOT-32 plastic envelope, recommended for driver stages in hi-fi amplifiers and television circuits.
The BD135, BD137 and BD139 are complementary to the BD136, BD138 and BD140 respectively.

QUICK REFERENCE DATA

			BD136	BD138	BD140	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Collector current (d.c.)	$-I_C$	max.	1,5	1,5	1,5	A
Collector current (peak value)	$-I_{CM}$	max.	2,0	2,0	2,0	A
Total power dissipation up to T_{mb} = 70 °C	P_{tot}	max.	8	8	8	W
Junction temperature	T_j	max.	150	150	150	°C
D.C. current gain $-I_C$ = 150 mA; $-V_{CE}$ = 2 V	h_{FE}	>	40	40	40	
		<	250	250	250	
Transition frequency $-I_C$ = 50 mA; $-V_{CE}$ = 5 V	f_T	typ.	75	75	75	MHz

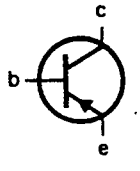
MECHANICAL DATA

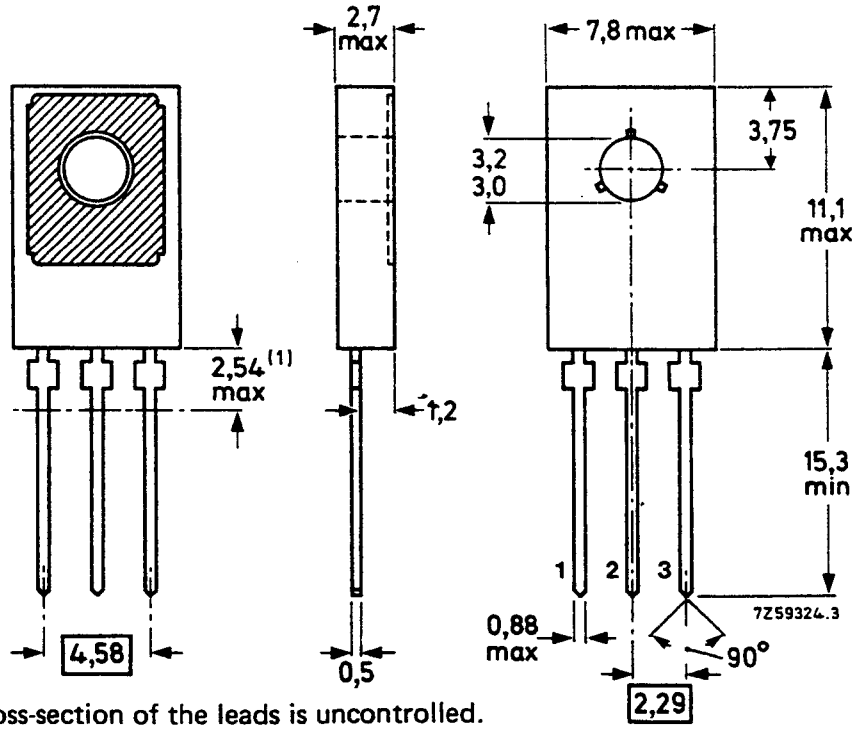
Dimensions in mm

Fig. 1 TO-126 (SOT-32).

Collector connected to metal part of mounting surface

Pinning
1 = emitter
2 = collector
3 = base





(1) Within this region the cross-section of the leads is uncontrolled.

See also chapters Mounting instructions and Accessories.

RATINGS

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

			BD136	BD138	BD140	
Collector-base voltage (open emitter)	$-V_{CBO}$	max.	45	60	100	V
Collector-emitter voltage (open base)	$-V_{CEO}$	max.	45	60	80	V
Collector-emitter voltage (R_{BE} = 1 kΩ)	$-V_{CER}$	max.	45	60	100	V
Emitter-base voltage (open collector)	$-V_{EBO}$	max.	5	5	5	V
Collector current (d.c.)	$-I_C$	max.	1,5	1,5	1,5	A
Collector current (peak value)	$-I_{CM}$	max.	2,0	2,0	2,0	A
Total power dissipation up to T_{mb} = 70 °C	P_{tot}	max.			8	W
Storage temperature	T_{stg}			−65 to +150		°C
Junction temperature	T_j	max.			150	°C

THERMAL RESISTANCE

From junction to ambient in free air	$R_{th\ j\text{-}a}$	100	K/W
From junction to mounting base	$R_{th\ j\text{-}mb}$	10	K/W

CHARACTERISTICS

T_j = 25 °C unless otherwise specified

Collector cut-off current				
I_E = 0; $-V_{CB}$ = 30 V	$-I_{CBO}$	<	100	nA
I_E = 0; $-V_{CB}$ = 30 V; T_j = 125 °C	$-I_{CBO}$	<	10	μA
Emitter cut-off current				
I_C = 0; $-V_{EB}$ = 5 V	$-I_{EBO}$	<	10	μA
Base-emitter voltage				
$-I_C$ = 500 mA; $-V_{CE}$ = 2 V	$-V_{EB}$	<	1	V
Saturation voltage				
$-I_C$ = 500 mA; $-I_B$ = 50 mA	$-V_{CEsat}$	<	0,5	V
D.C. current gain				
$-I_C$ = 5 mA; $-V_{CE}$ = 2 V	h_{FE}	>	25	
$-I_C$ = 150 mA; $-V_{CE}$ = 2 V				
BDxxx	h_{FE}		40 to 250	
BDxxx-06	h_{FE}		40 to 100	
BDxxx-10	h_{FE}		63 to 160	
BDxxx-16	h_{FE}		100 to 250	
$-I_C$ = 500 mA; $-V_{CE}$ = 2 V	h_{FE}	>	25	
Transition frequency at f = 35 MHz				
$-I_C$ = 50 mA; $-V_{CE}$ = 5 V	f_T	typ.	75	MHz
D.C. current gain ratio of matched pairs				
BD135/BD136; BD137/BD138; BD139/BD140				
$\|I_C\|$ = 150 mA; $\|V_{CE}\|$ = 2 V	h_{FE1}/h_{FE2}	typ.	1,3	
		<	1,6	

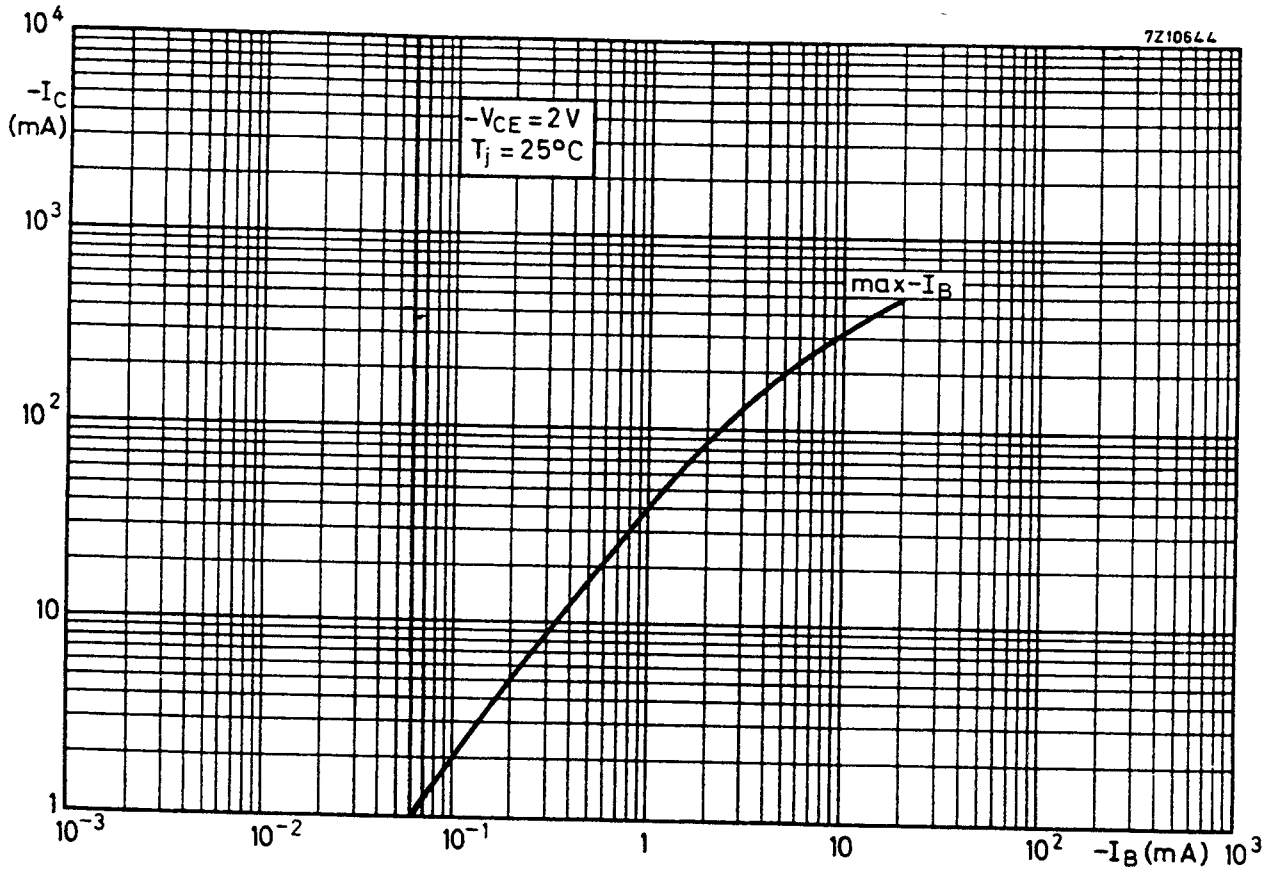

7Z10644
10^4
$-I_C$ (mA)
10^3
10^2
10
1
$-V_{CE} = 2V$
$T_j = 25°C$
max-I_B
10^{-3}
10^{-2}
10^{-1}
1
10
10^2
$-I_B$ (mA)
10^3

Fig. 10.

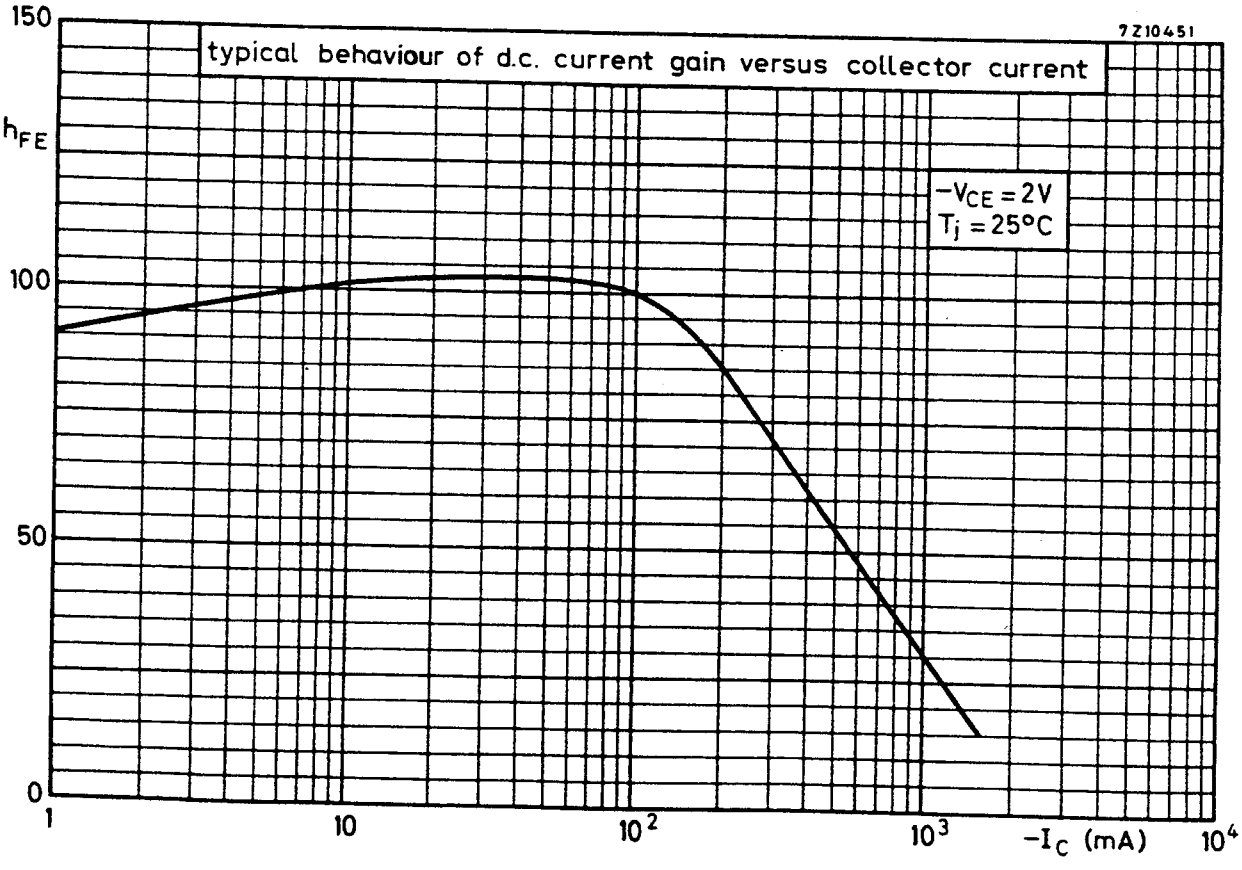

7Z10451
typical behaviour of d.c. current gain versus collector current
150
h_{FE}
100
50
0
$-V_{CE} = 2V$
$T_j = 25°C$
1
10
10^2
10^3
$-I_C$ (mA)
10^4

Fig. 11.

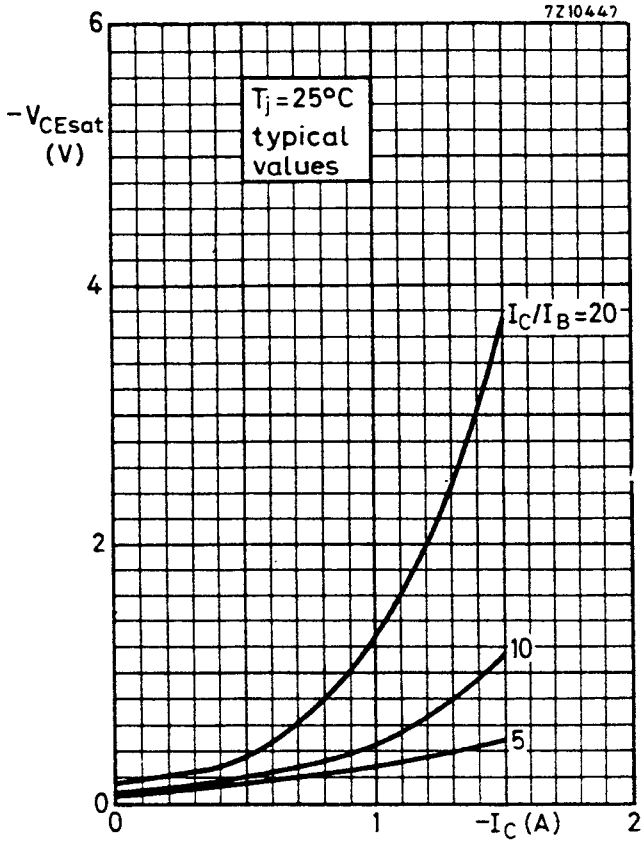


Fig. 12.

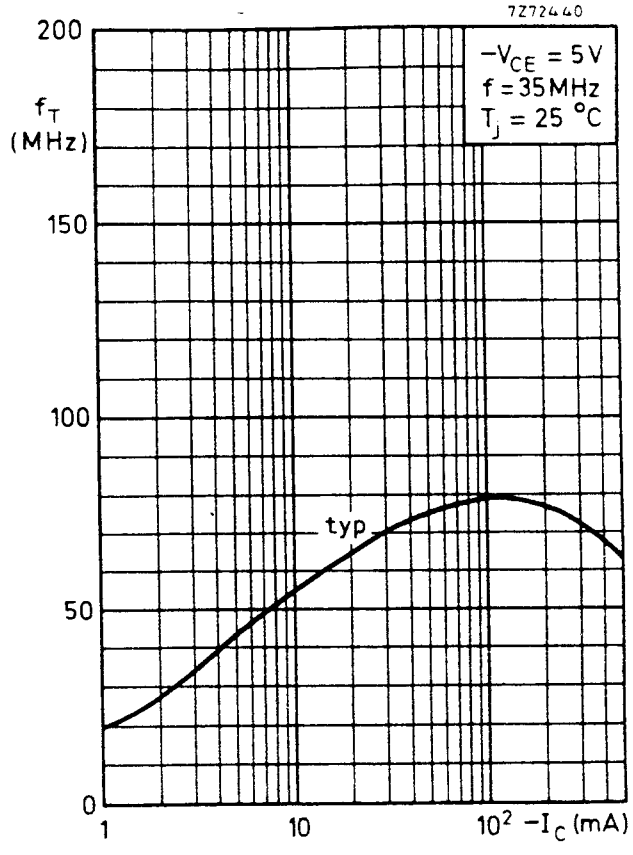


Fig. 13.

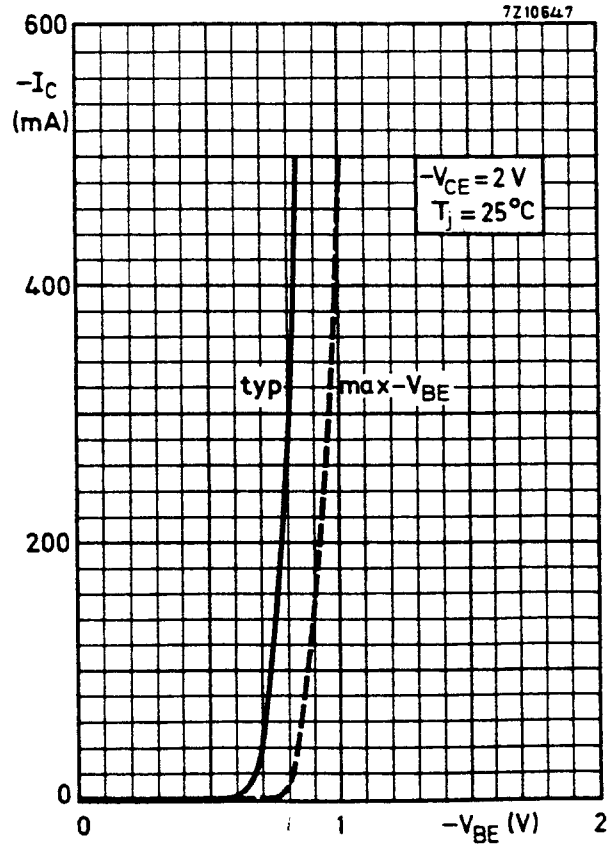


Fig. 14.

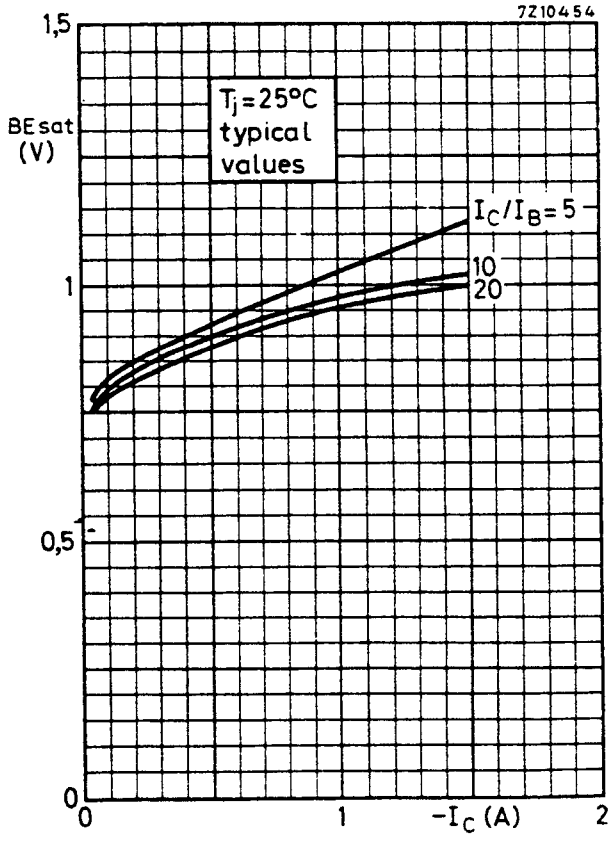


Fig. 15.