

NPN Silicon RF Transistor

- For low current applications
- For oscillators up to 12 GHz
- Noise figure F = 1.25 dB at 1.8 GHz
 outstanding G_{ms} = 23 dB at 1.8 GHz
- Transition frequency $f_T = 25 \text{ GHz}$
- Gold metallization for high reliability
- SIEGET ® 25 GHz fT Line
- Pb-free (RoHS compliant) package¹⁾
- Qualified according AEC Q101





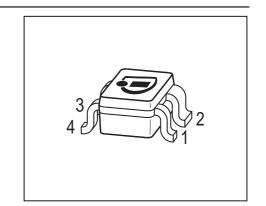
ESD (Electrostatic discharge) sensitive device, observe handling precaution!

Туре	Marking	Pin Configuration				Package		
BFP405	ALs	1=B	2=E	3=C	4=E	-	-	SOT343

Maximum Ratings

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CEO}		V
<i>T</i> _A > 0 °C		4.5	
		4.1	
Collector-emitter voltage	V_{CES}	15	
Collector-base voltage	V_{CBO}	15	
Emitter-base voltage	V_{EBO}	1.5	
Collector current	I _C	12	mA
Base current	I _B	1	
Total power dissipation ²⁾	P_{tot}	55	mW
<i>T</i> _S ≤ 120 °C			
Junction temperature	T_{i}	150	°C
Ambient temperature	TA	-65 150	
Storage temperature	$T_{\rm stg}$	-65 150	

¹Pb-containing package may be available upon special request



 $^{^2}T_{\mbox{S}}$ is measured on the collector lead at the soldering point to the pcb



Thermal Resistance

Parameter	Symbol	Value	Unit
Junction - soldering point ¹⁾	R_{thJS}	≤ 520	K/W

Electrical Characteristics at $T_A = 25$ °C, unless otherwise specified

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
DC Characteristics					
Collector-emitter breakdown voltage	V _{(BR)CEO}	4.5	5	-	V
$I_{\rm C} = 1 \text{ mA}, I_{\rm B} = 0$, ,				
Collector-emitter cutoff current	I _{CES}	-		10	μΑ
$V_{CE} = 15 \text{ V}, \ V_{BE} = 0$					
Collector-base cutoff current	I _{CBO}	-	-	100	nA
$V_{CB} = 5 \text{ V}, I_{E} = 0$					
Emitter-base cutoff current	I _{EBO}	-		1	μΑ
$V_{EB} = 0.5 \text{ V}, I_{C} = 0$					
DC current gain	h _{FE}	60	95	130	-
$I_{\rm C}$ = 5 mA, $V_{\rm CE}$ = 4 V, pulse measured					

 $^{^{1}\}mbox{For calculation of}~R_{\mbox{\scriptsize thJA}}$ please refer to Application Note Thermal Resistance



Electrical Characteristics at $T_A = 25$ °C, unless otherwise specified

Parameter	Symbol Values			Unit			
		min.	typ.	max.			
AC Characteristics (verified by random sampling)							
Transition frequency	f_{T}	18	25	-	GHz		
$I_{\rm C}$ = 10 mA, $V_{\rm CE}$ = 3 V, f = 2 GHz							
Collector-base capacitance	C _{cb}	-	0.05	0.1	pF		
$V_{CB} = 2 \text{ V}, f = 1 \text{ MHz}, V_{BE} = 0,$							
emitter grounded							
Collector emitter capacitance	C_{ce}	-	0.24	-			
$V_{CE} = 2 \text{ V}, f = 1 \text{ MHz}, V_{BE} = 0,$							
base grounded							
Emitter-base capacitance	C _{eb}	-	0.29	-			
$V_{EB} = 0.5 \text{ V}, f = 1 \text{ MHz}, V_{CB} = 0$,							
collector grounded							
Noise figure	F	-	1.25	-	dB		
$I_{C} = 2 \text{ mA}, V_{CE} = 2 \text{ V}, f = 1.8 \text{ GHz}, Z_{S} = Z_{Sopt}$							
Power gain, maximum stable ¹⁾	G _{ms}	-	23	-	dB		
$I_{C} = 5 \text{ mA}, V_{CE} = 2 \text{ V}, Z_{S} = Z_{Sopt},$							
$Z_{L} = Z_{Lopt}$, $f = 1.8 \text{ GHz}$							
Insertion power gain	$ S_{21} ^2$	14	18.5	-			
$V_{CE} = 2 \text{ V}, I_{C} = 5 \text{ mA}, f = 1.8 \text{ GHz},$							
$Z_{\rm S} = Z_{\rm L} = 50 \ \Omega$							
Third order intercept point at output ²⁾	IP ₃	-	15	-	dBm		
$V_{CE} = 2 \text{ V}, I_{C} = 5 \text{ mA}, f = 1.8 \text{ GHz},$							
$Z_{\rm S} = Z_{\rm L} = 50 \ \Omega$							
1dB Compression point at output	P _{-1dB}	-	5	-			
$I_{\rm C} = 5 \text{ mA}, \ V_{\rm CE} = 2 \text{ V}, \ Z_{\rm S} = Z_{\rm L} = 50 \ \Omega,$							
f = 1.8 GHz							

 $^{^{1}}G_{ms} = |S_{21} / S_{12}|$

²IP3 value depends on termination of all intermodulation frequency components.

Termination used for this measurement is 50Ω from 0.1 MHz to 6 GHz



SPICE Parameter (Gummel-Poon Model, Berkley-SPICE 2G.6 Syntax):

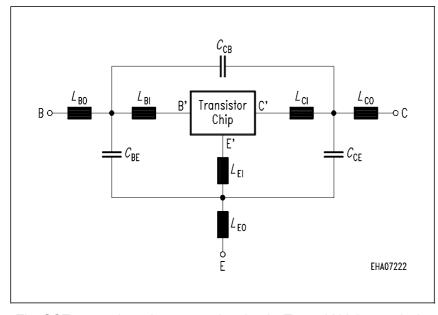
Transistor Chip Data:

IS =	0.21024	fA	BF =	83.23	-	NF =	1.0405	-
VAF =	39.251	V	IKF =	0.16493	Α	ISE =	15.761	fA
NE =	1.7763	-	BR =	10.526	-	NR =	0.96647	-
VAR =	34.368	V	IKR =	0.25052	mΑ	ISC =	0.037223	fA
NC =	1.3152	-	RB =	15	Ω	IRB =	0.21215	mΑ
RBM =	1.3491	Ω	RE =	1.9289	-	RC =	0.12691	Ω
CJE =	3.7265	fF	VJE =	0.70367	V	MJE =	0.37747	-
TF =	4.5899	ps	XTF =	0.3641	-	VTF =	0.19762	V
ITF =	1.3364	Α	PTF =	0	deg	CJC =	96.941	fF
VJC =	0.99532	V	MJC =	0.48652	-	XCJC =	0.08161	-
TR =	1.4935	ns	CJS =	0	fF	VJS =	0.75	V
MJS =	0	-	XTB =	0	-	EG =	1.11	eV
XTI =	3	-	FC =	0.99469		TNOM	300	K

C'-E'-dioden Data (Berkley-Spice 1G.6 Syntax): IS = 2 fA; N = 1.02 -, $RS = 20 \Omega$

All parameters are ready to use, no scalling is necessary.

Package Equivalent Circuit:



$$L_{\text{BI}} = 0.47$$
 pH
 $L_{\text{BO}} = 0.53$ pH
 $L_{\text{EI}} = 0.23$ pH
 $L_{\text{EO}} = 0.05$ nH
 $L_{\text{CI}} = 0.56$ nH
 $L_{\text{CO}} = 0.58$ nH
 $L_{\text{CO}} = 0.58$ fF
 $L_{\text{CB}} = 136$ fF
 $L_{\text{CC}} = 0.9$ fF
 $L_{\text{CC}} = 0.9$ fF

The SOT343 package has two emitter leads. To avoid high complexity to the package equivalent circuit both leads are combined in one electrical connection

Extracted on behalf of Infineon Technologies AG by: Institut für Mobil- und Satellitentechnik (IMST)

For examples and ready to use parameters please contact your local Infineon Technologies distributor or sales office to obtain a InfineonTechnologies CD-ROM or see Internet: http://www.infineon.com/silicondiscretes

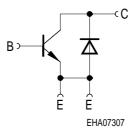


For non-linear simulation:

- · Use transistor chip parameters in Berkeley SPICE 2G.6 syntax for all simulators.
- If you need simulation of the reverse characteristics, add the diode with the C'-E'- diode data between collector and emitter.
- Simulation of package is not necessary for frequencies < 100MHz.
 For higher frequencies add the wiring of package equivalent circuit around the non-linear transistor and diode model.

Note:

 This transistor is constructed in a common emitter configuration. This feature causes an additional reverse biased diode between emitter and collector, which does not effect normal operation.



Transistor Schematic Diagram

The common emitter configuration shows the following advantages:

- · Higher gain because of lower emitter inductance.
- Power is dissipated via the grounded emitter leads, because the chip is mounted on copper emitter leadframe.

Please note, that the broadest lead is the emitter lead.

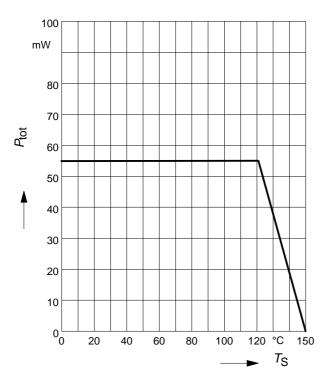
Common Emitter S- and Noise-parameter

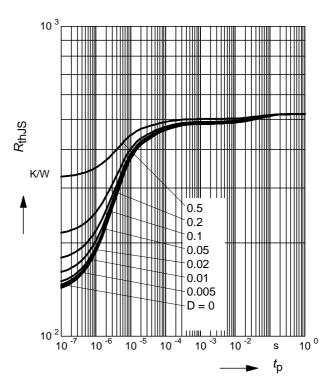
For detailed S- and Noise-parameters please contact your local Infineon Technologies distributor or sales office to obtain a Infineon Technologies Application Notes CD-ROM or see Internet: http://www.infineon.com/silicondiscretes



Total power dissipation $P_{\text{tot}} = f(T_{\text{S}})$

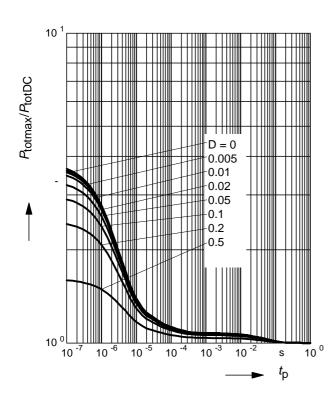
Permissible Pulse Load $R_{thJS} = f(t_p)$



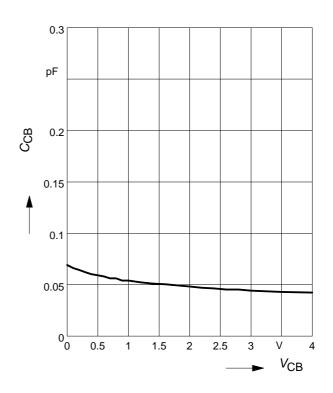


Permissible Pulse Load

 $P_{\text{totmax}}/P_{\text{totDC}} = f(t_{p})$



Collector-base capacitance $C_{CD} = f(V_{CB})$ f = 1MHz

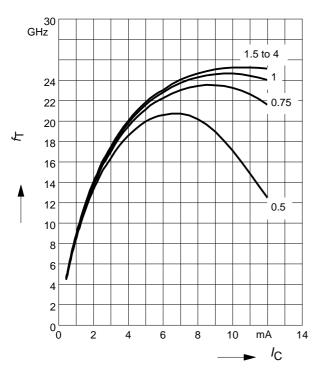




Transition frequency $f_T = f(I_C)$

f = 2 GHz

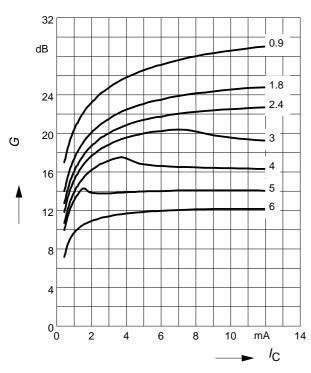
 V_{CE} = parameter in V



Power gain G_{ma} , $G_{ms} = f(I_C)$

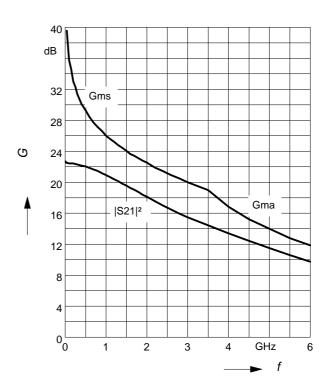
 $V_{CE} = 2V$

f = parameter in GHz



Power gain G_{ma} , G_{ms} , $|S_{21}|^2 = f(f)$

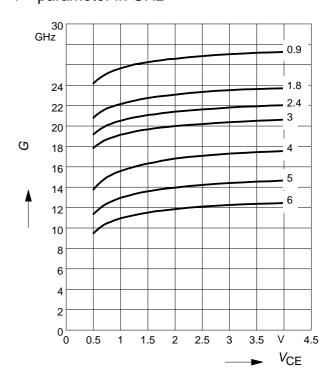
$$V_{CE} = 2 \text{ V}, I_{C} = 5 \text{ mA}$$



Power gain G_{ma} , $G_{ms} = f(V_{CE})$

 $I_{\rm C} = 5 \, \text{mA}$

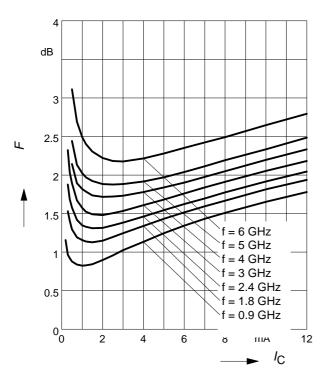
f = parameter in GHz





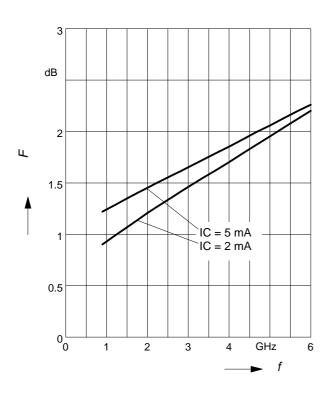
Noise figure $F = f(I_{\mathbb{C}})$

$$V_{CE} = 2 \text{ V}, Z_{S} = Z_{Sopt}$$



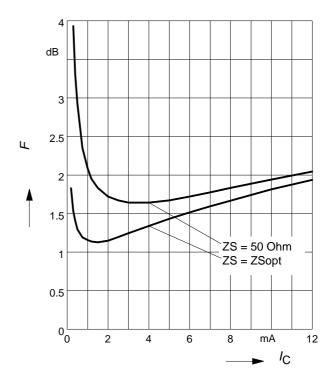
Noise figure F = f(f)

$$V_{CE} = 1 \text{ V}, Z_{S} = Z_{Sopt}$$



Noise figure $F = f(I_C)$

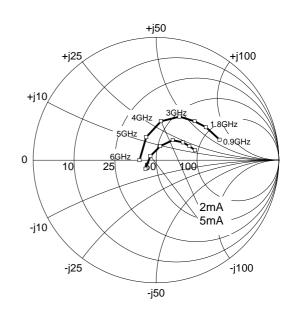
$$V_{CE} = 2 \text{ V}, f = 1.8 \text{ GHz}$$



Source impedance for min.

noise figure vs. frequency

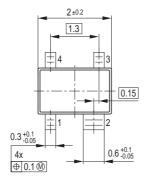
$$V_{CE} = 3 \text{ V}, I_{C} = 2 \text{ mA} / 5 \text{ mA}$$

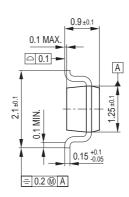




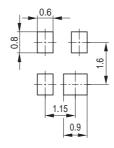
Package Outline



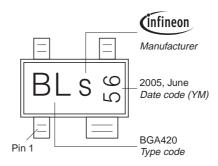




Foot Print

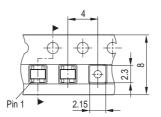


Marking Layout (Example)



Standard Packing

Reel ø180 mm = 3.000 Pieces/Reel Reel ø330 mm = 10.000 Pieces/Reel







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