

## Low Noise Silicon Bipolar RF Transistor

- For low noise, high-gain amplifiers up to 2 GHz
- For linear broadband amplifiers
- $f_T = 8 \text{ GHz}$ ,  $NF_{\min} = 1 \text{ dB}$  at 900 MHz
- Pb-free (RoHS compliant) and halogen-free product
- Qualification report according to AEC-Q101 available



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

Type	Marking	Pin Configuration			Package
BFR193F	RCs	1 = B	2 = E	3 = C	TSFP-3

**Maximum Ratings** at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Parameter	Symbol	Value	Unit
Collector-emitter voltage	$V_{CEO}$	12	V
Collector-emitter voltage	$V_{CES}$	20	
Collector-base voltage	$V_{CBO}$	20	
Emitter-base voltage	$V_{EBO}$	2	
Collector current	$I_C$	80	mA
Base current	$I_B$	10	
Total power dissipation <sup>1)</sup> $T_S \leq 72^\circ\text{C}$	$P_{\text{tot}}$	580	mW
Junction temperature	$T_J$	150	$^\circ\text{C}$
Storage temperature	$T_{\text{Stg}}$	-55 ... 150	

### Thermal Resistance

Parameter	Symbol	Value	Unit
Junction - soldering point <sup>2)</sup>	$R_{\text{thJS}}$	135	K/W

<sup>1)</sup>  $T_S$  is measured on the collector lead at the soldering point to the pcb

<sup>2)</sup> For the definition of  $R_{\text{thJS}}$  please refer to Application Note AN077 (Thermal Resistance Calculation)

**Electrical Characteristics** at  $T_A = 25\text{ °C}$ , unless otherwise specified

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
DC Characteristics					
Collector-emitter breakdown voltage $I_C = 1\text{ mA}$ , $I_B = 0$	$V_{(BR)CEO}$	12	-	-	V
Collector-emitter cutoff current $V_{CE} = 20\text{ V}$ , $V_{BE} = 0$	$I_{CES}$	-	-	100	$\mu\text{A}$
Collector-base cutoff current $V_{CB} = 10\text{ V}$ , $I_E = 0$	$I_{CBO}$	-	-	100	nA
Emitter-base cutoff current $V_{EB} = 1\text{ V}$ , $I_C = 0$	$I_{EBO}$	-	-	1	$\mu\text{A}$
DC current gain $I_C = 30\text{ mA}$ , $V_{CE} = 8\text{ V}$ , pulse measured	$h_{FE}$	70	100	140	-

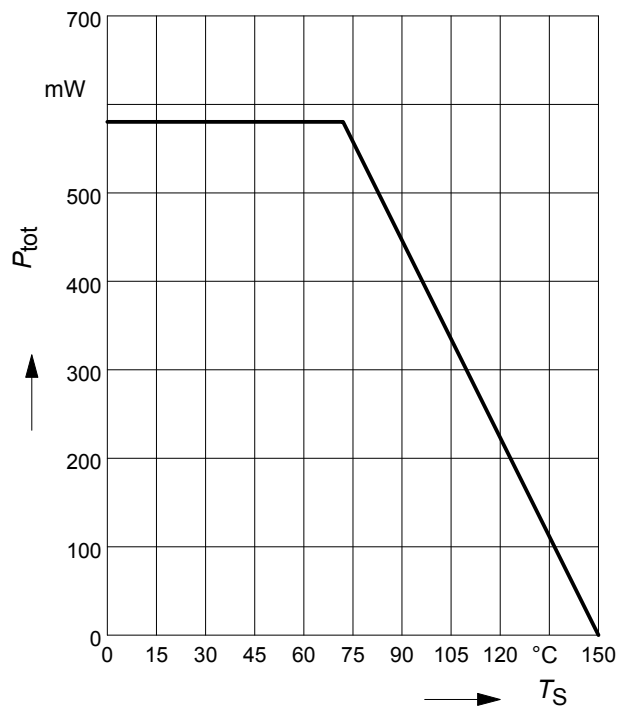
**Electrical Characteristics** at  $T_A = 25^\circ\text{C}$ , unless otherwise specified

Parameter	Symbol	Values			Unit
		min.	typ.	max.	
AC Characteristics (verified by random sampling)					
Transition frequency $I_C = 50\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $f = 500\text{ MHz}$	$f_T$	6	8	-	GHz
Collector-base capacitance $V_{CB} = 10\text{ V}$ , $f = 1\text{ MHz}$ , $V_{BE} = 0$ , emitter grounded	$C_{cb}$	-	0.63	1	pF
Collector emitter capacitance $V_{CE} = 10\text{ V}$ , $f = 1\text{ MHz}$ , $V_{BE} = 0$ , base grounded	$C_{ce}$	-	0.25	-	
Emitter-base capacitance $V_{EB} = 0.5\text{ V}$ , $f = 1\text{ MHz}$ , $V_{CB} = 0$ , collector grounded	$C_{eb}$	-	2.25	-	
Minimum noise figure $I_C = 10\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $Z_S = Z_{Sopt}$ , $f = 900\text{ MHz}$ $f = 1.8\text{ GHz}$	$NF_{min}$	- -	1 1.6	- -	dB
Power gain, maximum stable <sup>1)</sup> $I_C = 30\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $Z_S = Z_{Sopt}$ , $Z_L = Z_{Lopt}$ , $f = 900\text{ MHz}$	$G_{ms}$	-	12.5	-	dB
Power gain, maximum available <sup>1)</sup> $I_C = 30\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $Z_S = Z_{Sopt}$ , $Z_L = Z_{Lopt}$ , $f = 1.8\text{ GHz}$	$G_{ma}$	-	19	-	dB
Transducer gain $I_C = 30\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $Z_S = Z_L = 50\Omega$ , $f = 900\text{ MHz}$ $f = 1.8\text{ GHz}$	$ S_{21e} ^2$	- -	14.5 8.5	- -	dB
Third order intercept point at output <sup>2)</sup> $V_{CE} = 8\text{ V}$ , $I_C = 30\text{ mA}$ , $f = 900\text{ MHz}$ , $Z_S = Z_L = 50\ \Omega$	$IP_3$	-	29	-	dBm
1dB compression point at output <sup>3)</sup> $I_C = 30\text{ mA}$ , $V_{CE} = 8\text{ V}$ , $Z_S = Z_L = 50\ \Omega$ , $f = 900\text{ MHz}$	$P_{-1dB}$	-	14.5	-	

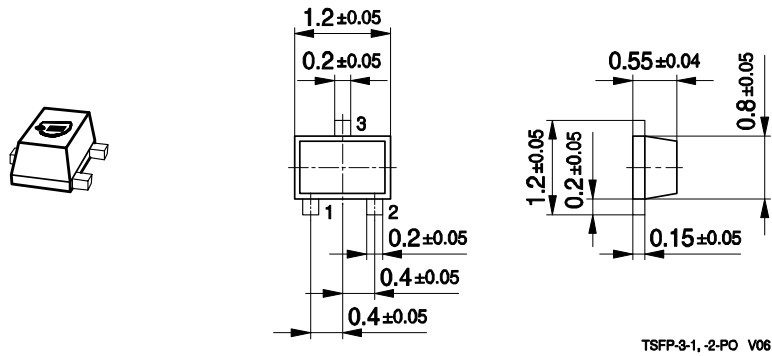
<sup>1)</sup>  $G_{ma} = |S_{21} / S_{12}| (k - (k^2 - 1)^{1/2})$ ,  $G_{ms} = |S_{21} / S_{12}|$ 
<sup>2)</sup>  $IP_3$  value depends on termination of all intermodulation frequency components.  
Termination used for this measurement is  $50\Omega$  from 0.1 MHz to 6 GHz

<sup>3)</sup> DC current at no input power

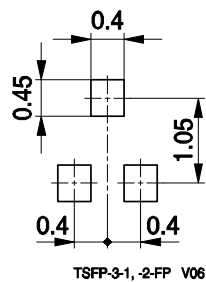
**Total power dissipation  $P_{\text{tot}} = f(T_S)$**



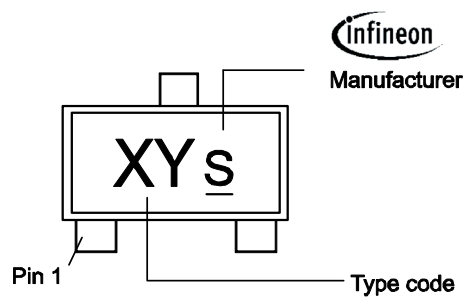
## Package Outline



## Foot Print



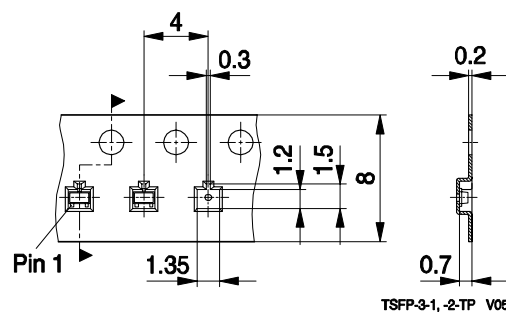
## Marking Layout (Example)



## Standard Packing

Reel Ø 180 mm = 3.000 Pieces/Reel

Reel Ø 330 mm = 10.000 Pieces/Reel



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