

Low Noise Silicon Bipolar RF Transistor

- Low noise amplifier for low current applications
- Collector design supports 5 V supply voltage
- For oscillators up to 3.5 GHz
- Low noise figure 1.0 dB at 1.8 GHz
- Pb-free (RoHS compliant) and halogen-free thin small flat package with visible leads
- Qualification report according to AEC-Q101 available



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

Type	Marking	Pin Configuration			Package
BFR360F	FBs	1 = B	2 = E	3 = C	TSFP-3

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

Parameter	Symbol	Value	Unit
Collector-emitter voltage	V_{CEO}	6	V
Collector-emitter voltage	V_{CES}	15	
Collector-base voltage	V_{CBO}	15	
Emitter-base voltage	V_{EBO}	2	
Collector current	I_C	35	mA
Base current	I_B	4	
Total power dissipation ¹⁾ $T_S \leq 98\text{ }^\circ\text{C}$	P_{tot}	210	mW
Junction temperature	T_J	150	$^\circ\text{C}$
Storage temperature	T_{Stg}	-55 ... 150	

Thermal Resistance

Parameter	Symbol	Value	Unit
Junction - soldering point ²⁾	R_{thJS}	250	K/W

¹⁾ T_S is measured on the collector lead at the soldering point to the pcb

²⁾ For the definition of R_{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 $I_C = 1\text{ mA}$, $I_B = 0$	$V_{(BR)CEO}$	6	9	-	V
Collector-emitter cutoff current $V_{CE} = 4\text{ V}$, $V_{BE} = 0$ $V_{CE} = 10\text{ V}$, $V_{BE} = 0$, $T_A = 85\text{ °C}$ Verified by random sampling	I_{CES}	-	1	30	nA
		-	2	50	
Collector-base cutoff current $V_{CB} = 4\text{ V}$, $I_E = 0$	I_{CBO}	-	1	30	
Emitter-base cutoff current $V_{EB} = 1\text{ V}$, $I_C = 0$	I_{EBO}	-	1	500	
DC current gain $I_C = 15\text{ mA}$, $V_{CE} = 3\text{ V}$, pulse measured	h_{FE}	90	120	160	-

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

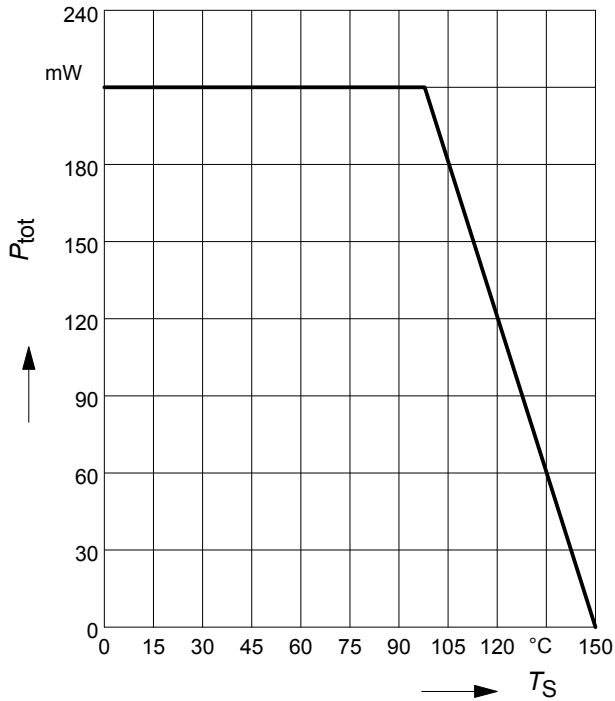
Parameter	Symbol	Values			Unit
		min.	typ.	max.	
AC Characteristics (verified by random sampling)					
Transition frequency $I_C = 15\text{ mA}$, $V_{CE} = 3\text{ V}$, $f = 1\text{ GHz}$	f_T	11	14	-	GHz
Collector-base capacitance $V_{CB} = 5\text{ V}$, $f = 1\text{ MHz}$, $V_{BE} = 0$, emitter grounded	C_{cb}	-	0.32	0.5	pF
Collector emitter capacitance $V_{CE} = 5\text{ V}$, $f = 1\text{ MHz}$, $V_{BE} = 0$, base grounded	C_{ce}	-	0.2	-	
Emitter-base capacitance $V_{EB} = 0.5\text{ V}$, $f = 1\text{ MHz}$, $V_{CB} = 0$, collector grounded	C_{eb}	-	0.4	-	
Minimum noise figure $I_C = 3\text{ mA}$, $V_{CE} = 3\text{ V}$, $Z_S = Z_{Sopt}$, $f = 1.8\text{ GHz}$	NF_{min}	-	1	-	dB
Power gain, maximum available ¹⁾ $I_C = 15\text{ mA}$, $V_{CE} = 3\text{ V}$, $Z_S = Z_{Sopt}$, $Z_L = Z_{Lopt}$, $f = 1.8\text{ GHz}$ $f = 3\text{ GHz}$	G_{ma}	- -	15.5 11	- -	
Transducer gain $I_C = 15\text{ mA}$, $V_{CE} = 3\text{ V}$, $Z_S = Z_L = 50\Omega$, $f = 1.8\text{ GHz}$ $f = 3\text{ GHz}$	$ S_{21e} ^2$	- -	13 9	- -	dB
Third order intercept point at output ²⁾ $V_{CE} = 3\text{ V}$, $I_C = 15\text{ mA}$, $f = 1.8\text{ GHz}$, $Z_S = Z_L = 50\Omega$	$IP3$	-	24	-	dBm
1dB compression point at output $I_C = 15\text{ mA}$, $V_{CE} = 3\text{ V}$, $Z_S = Z_L = 50\Omega$, $f = 1.8\text{ GHz}$	P_{-1dB}	-	9	-	

$$^1G_{ma} = |S_{21e} / S_{12e}| (k - (k^2 - 1)^{1/2})$$

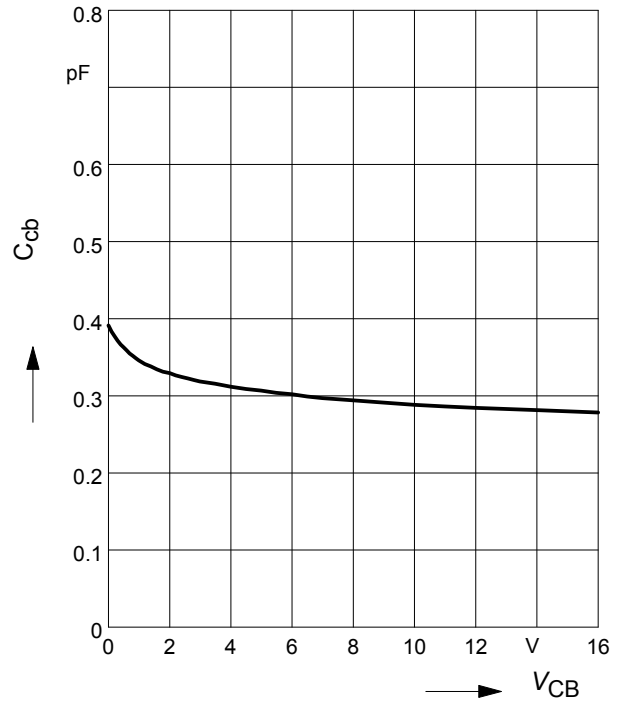
²IP3 value depends on termination of all intermodulation frequency components.

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

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



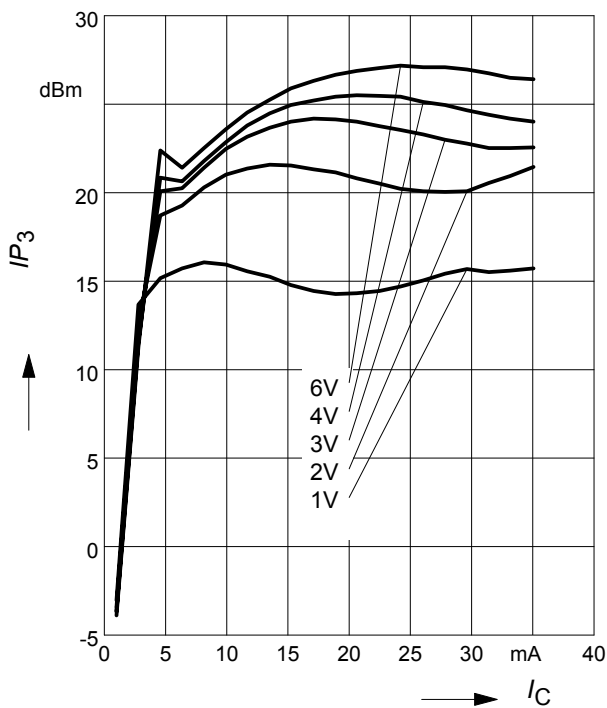
**Collector-base capacitance $C_{cb} = f(V_{CB})$
 $f = 1\text{MHz}$**



Third order Intercept Point $IP_3 = f(I_C)$

(Output, $Z_S = Z_L = 50\Omega$)

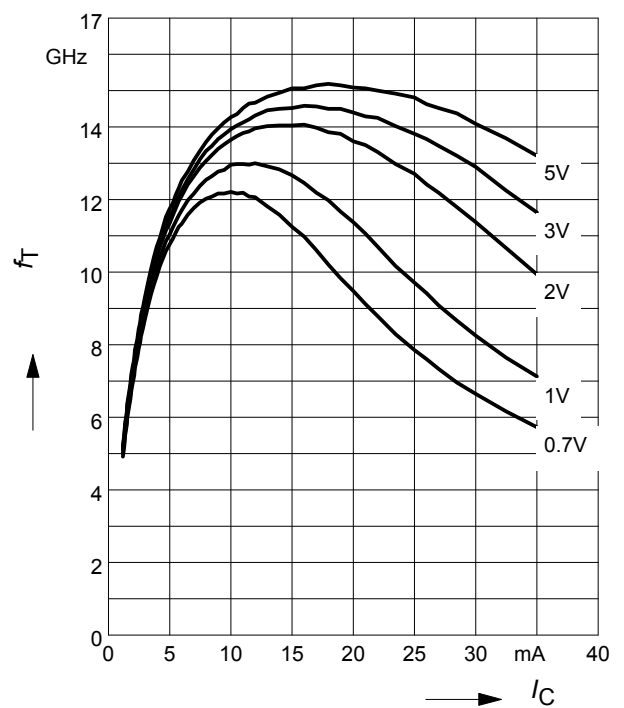
$V_{CE} = \text{parameter}, f = 1.8\text{GHz}$



Transition frequency $f_T = f(I_C)$

$f = 1\text{GHz}$

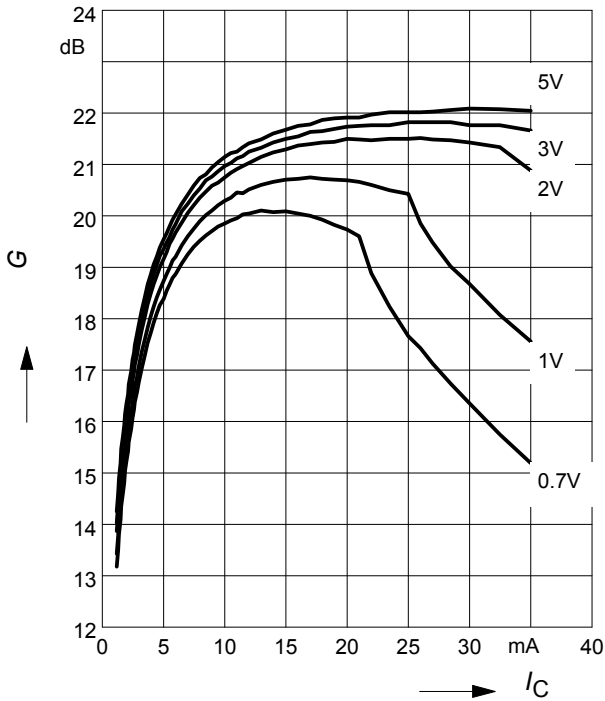
$V_{CE} = \text{parameter}$



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

$f = 0.9\text{GHz}$

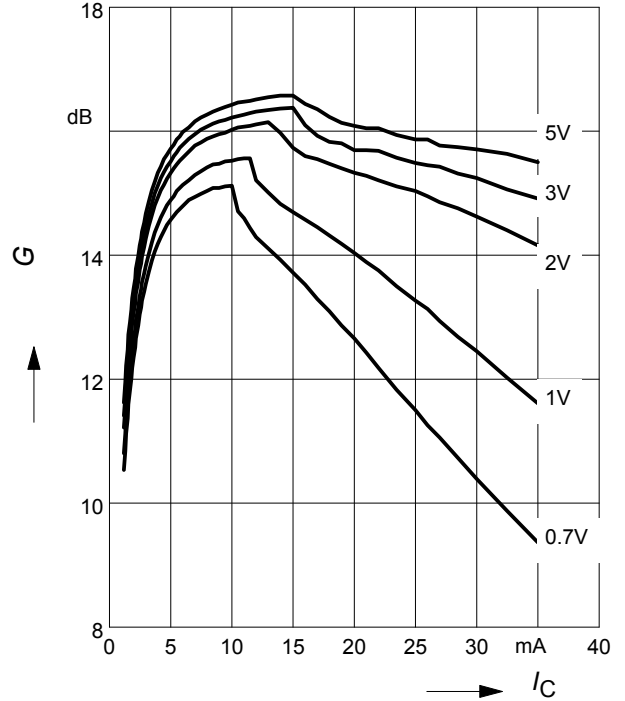
$V_{CE} = \text{parameter}$



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

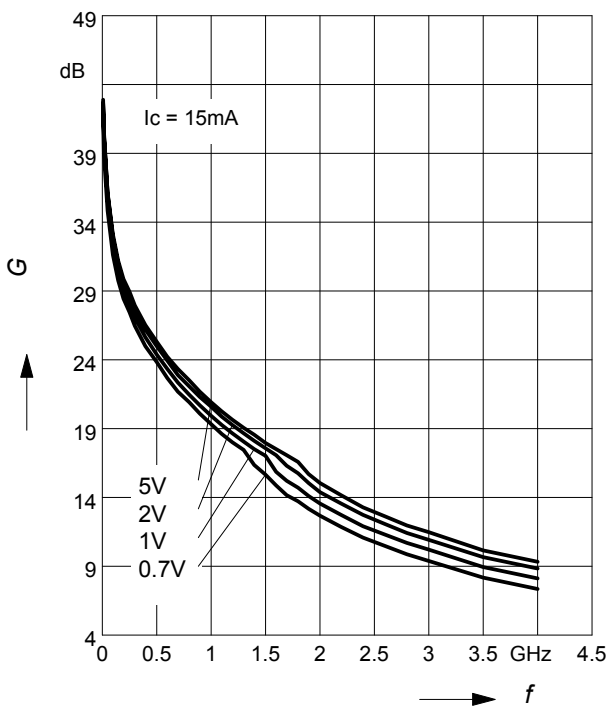
$f = 1.8\text{GHz}$

$V_{CE} = \text{parameter}$



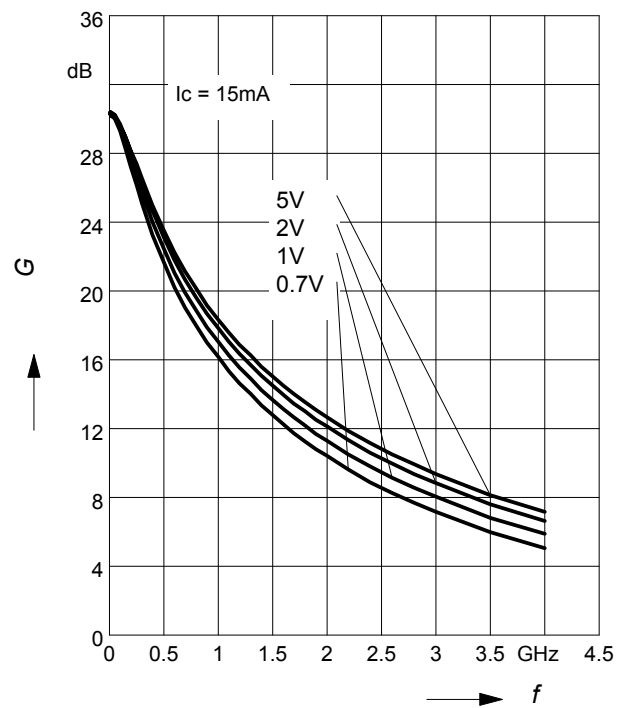
Power Gain G_{ma} , $G_{ms} = f(f)$

$V_{CE} = \text{parameter}$



Insertion Power Gain $|S_{21}|^2 = f(f)$

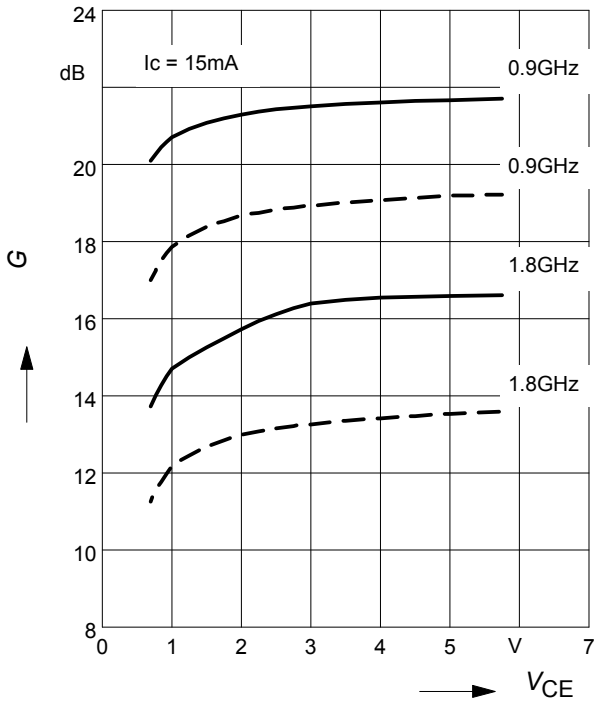
$V_{CE} = \text{parameter}$



Power Gain G_{ma} , $G_{ms} = f(V_{CE})$: —

$|S_{21}|^2 = f(V_{CE})$: - - - -

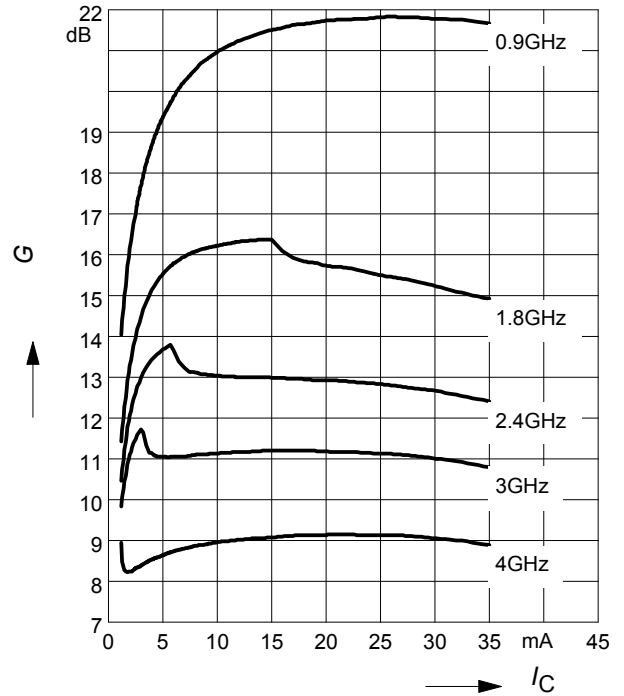
$f =$ parameter



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

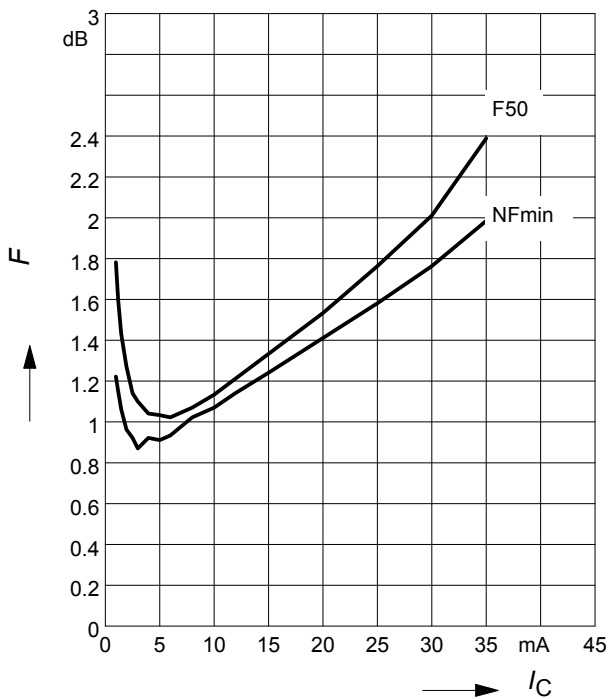
$V_{CE} = 3V$

$f =$ parameter



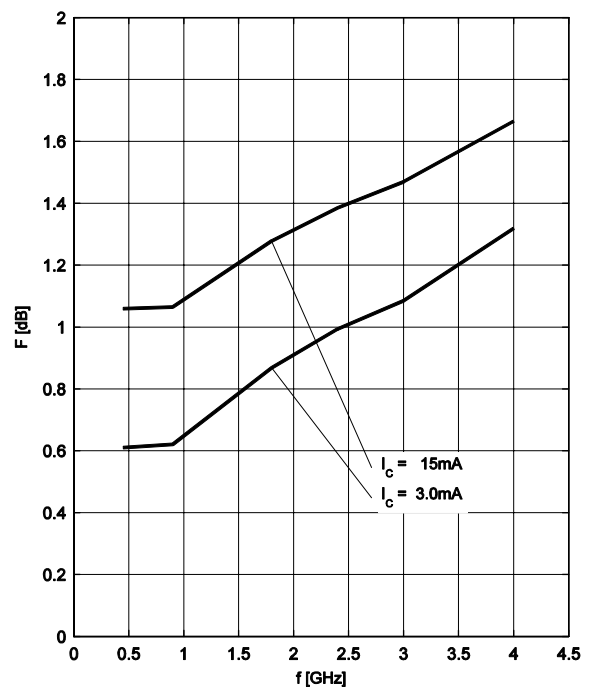
Noise figure $NF = f(I_C)$

$V_{CE} = 3V, f = 1,8 \text{ GHz}$



Noise figure $F = f(f)$

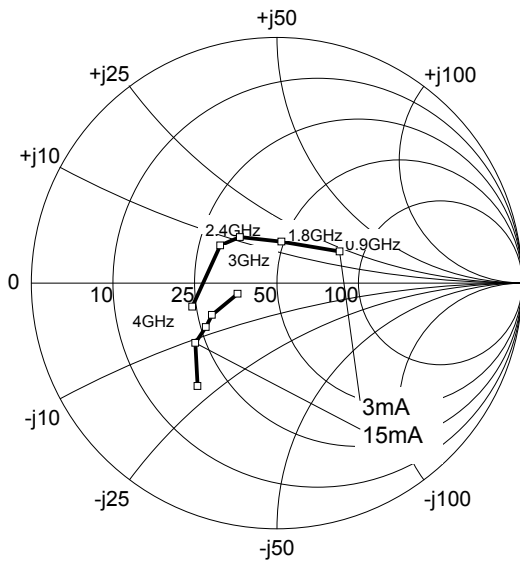
$V_{CE} = 3V, Z_S = Z_{Sopt}$



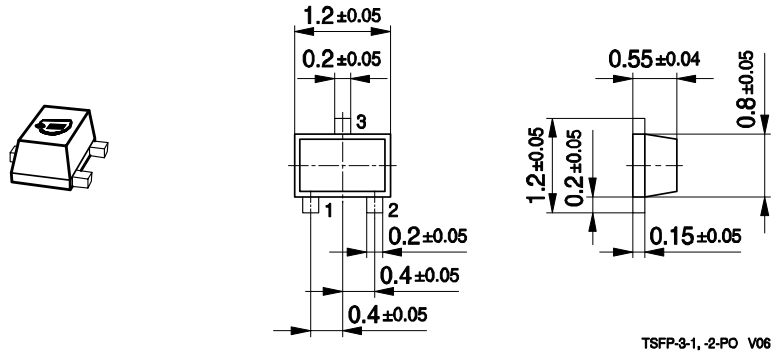
Source impedance for min.

noise figure vs. frequency

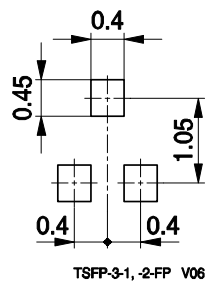
$V_{CE} = 3\text{ V}$



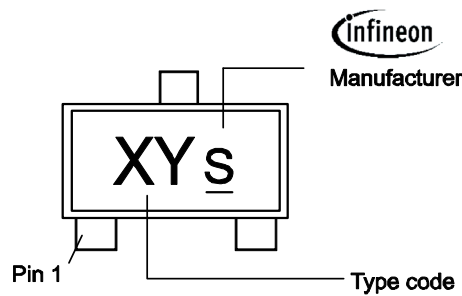
Package Outline



Foot Print



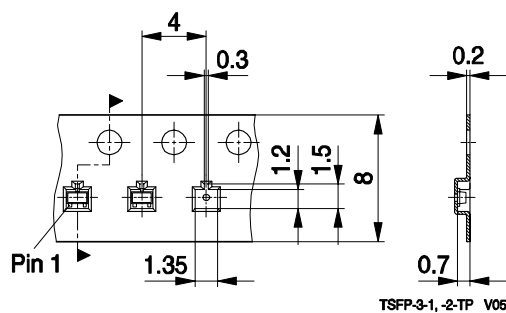
Marking Layout (Example)



Standard Packing

Reel Ø 180 mm = 3.000 Pieces/Reel

Reel Ø 330 mm = 10.000 Pieces/Reel



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