

## Silicon NPN Planar RF Transistor

### Features

- High power gain
- High transition frequency
- Low noise figure
- Lead (Pb)-free component
- Component in accordance to RoHS 2002/95/EC and WEEE 2002/96/EC



### Applications

- Wide band amplifier up to GHz range

### Mechanical Data

**Typ:** BFR93A

**Case:** SOT23 Plastic case

**Weight:** approx. 8.0 mg

**Marking:** + R2

**Pinning:** 1 = Collector, 2 = Base, 3 = Emitter

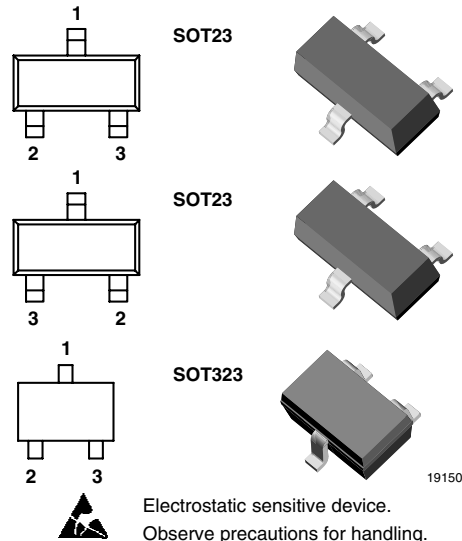
**Typ:** BFR93AR

**Case:** SOT23 Plastic case

**Weight:** approx. 8.0 mg

**Marking:** + R5

**Pinning:** 1 = Collector, 2 = Base, 3 = Emitter



**Typ:** BFR93AW

**Case:** SOT323 Plastic case

**Weight:** approx. 8.0 mg

**Marking:** WR2

**Pinning:** 1 = Collector, 2 = Base, 3 = Emitter

### Parts Table

Part	Ordering Code	Type Marking	Remarks	Package
BFR93A	BFR93AGELB-GS08	+ R2	Tape and Reel	SOT23
BFR93AR	BFR93ARGELB-GS08	+ R5	Tape and Reel	SOT23
BFR93AW	BFR93AW-GS08	WR2	Tape and Reel	SOT323

### Absolute Maximum Ratings

$T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified

Parameter	Test condition	Symbol	Value	Unit
Collector-base voltage		$V_{CBO}$	20	V
Collector-emitter voltage		$V_{CEO}$	12	V
Emitter-base voltage		$V_{EBO}$	2	V
Collector current		$I_C$	50	mA
Total power dissipation	$T_{amb} \leq 60\text{ }^{\circ}\text{C}$	$P_{tot}$	200	mW
Junction temperature		$T_j$	150	$^{\circ}\text{C}$
Storage temperature range		$T_{stg}$	- 65 to + 150	$^{\circ}\text{C}$

### Maximum Thermal Resistance

Parameter	Test condition	Symbol	Value	Unit
Junction ambient	1)	$R_{thJA}$	450	K/W

1) on glass fibre printed board (25 x 20 x 1.5) mm<sup>3</sup> plated with 35 μm Cu

### Electrical DC Characteristics

$T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified

Parameter	Test condition	Symbol	Min	Typ.	Max	Unit
Collector-emitter cut-off current	$V_{CE} = 20\text{ V}$ , $V_{BE} = 0$	$I_{CES}$			100	μA
Collector-base cut-off current	$V_{CB} = 10\text{ V}$ , $I_E = 0$	$I_{CBO}$			100	nA
Emitter-base cut-off current	$V_{EB} = 2\text{ V}$ , $I_C = 0$	$I_{EBO}$			10	μA
Collector-emitter breakdown voltage	$I_C = 1\text{ mA}$ , $I_B = 0$	$V_{(BR)CEO}$	12			V
Collector-emitter saturation voltage	$I_C = 50\text{ mA}$ , $I_B = 5\text{ mA}$	$V_{CEsat}$		0.1	0.4	V
DC forward current transfer ratio	$V_{CE} = 5\text{ V}$ , $I_C = 30\text{ mA}$	$h_{FE}$	40	90	150	

### Electrical AC Characteristics

$T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified

Parameter	Test condition	Symbol	Min	Typ.	Max	Unit
Transition frequency	$V_{CE} = 5\text{ V}$ , $I_C = 30\text{ mA}$ , $f = 500\text{ MHz}$	$f_T$		6		GHz
Collector-base capacitance	$V_{CB} = 10\text{ V}$ , $f = 1\text{ MHz}$	$C_{cb}$		0.45		pF
Collector-emitter capacitance	$V_{CE} = 5\text{ V}$ , $f = 1\text{ MHz}$	$C_{ce}$		0.2		pF
Emitter-base capacitance	$V_{EB} = 0.5\text{ V}$ , $f = 1\text{ MHz}$	$C_{eb}$		1.5		pF
Noise figure	$V_{CE} = 8\text{ V}$ , $Z_S = 50\text{ } \Omega$ , $f = 800\text{ MHz}$ , $I_C = 5\text{ mA}$	F		1.6		dB
	$V_{CE} = 8\text{ V}$ , $Z_S = 50\text{ } \Omega$ , $f = 800\text{ MHz}$ , $I_C = 25\text{ mA}$	F		2.1		dB
Power gain	$V_{CE} = 8\text{ V}$ , $I_C = 25\text{ mA}$ , $Z_S = 50\text{ } \Omega$ , $Z_L = Z_{Lopt}$ , $f = 800\text{ MHz}$	$G_{pe}$		14		dB
Linear output voltage - two tone intermodulation test	$V_{CE} = 8\text{ V}$ , $I_C = 25\text{ mA}$ , $d_{IM} = 60\text{ dB}$ , $f_1 = 806\text{ MHz}$ , $f_2 = 810\text{ MHz}$ , $Z_S = Z_L = 50\text{ } \Omega$	$V_1 = V_2$		260		mV
Third order intercept point	$V_{CE} = 8\text{ V}$ , $I_C = 25\text{ mA}$ , $f = 800\text{ MHz}$	$IP_3$		31		dBm



## Common Emitter S-Parameters

$Z_0 = 50 \Omega$ ,  $T_{amb} = 25 \text{ }^\circ\text{C}$ , unless otherwise specified

$V_{CE}/V$	$I_C/mA$	f/MHz	S11		S21		S12		S22	
			LIN MAG	ANG	LIN MAG	ANG	LIN MAG	ANG	LIN MAG	ANG
				deg		deg		deg		deg
8	5	100	0.811	- 33.9	12.66	152.2	0.028	72.8	0.914	- 15.0
		300	0.530	- 83.4	8.32	117.3	0.058	57.8	0.661	- 27.4
		500	0.370	- 116.3	5.67	99.8	0.075	56.7	0.537	- 26.9
		800	0.274	- 149.7	3.77	85.0	0.099	59.8	0.487	- 23.8
		1000	0.256	- 165.5	3.11	77.8	0.117	61.8	0.485	- 24.2
		1200	0.255	- 178.6	2.67	71.1	0.135	62.6	0.481	- 26.8
		1500	0.277	162.7	2.21	62.1	0.163	63.3	0.466	- 31.3
		1800	0.294	146.0	1.91	54.0	0.194	63.3	0.455	- 35.0
		2000	0.312	136.2	1.76	49.4	0.215	62.7	0.454	- 38.4
8	10	100	0.676	- 44.9	19.22	142.3	0.025	69.9	0.832	- 21.0
		300	0.377	- 97.1	10.24	108.0	0.050	62.8	0.539	- 29.0
		500	0.259	- 131.0	6.59	93.8	0.071	64.8	0.441	- 25.0
		800	0.197	- 164.2	4.26	81.6	0.102	66.9	0.415	- 20.4
		1000	0.189	- 178.0	3.48	75.4	0.124	67.2	0.423	- 21.1
		1200	0.195	169.8	2.98	69.5	0.147	66.7	0.424	- 24.2
		1500	0.222	155.6	2.46	61.4	0.179	65.4	0.409	- 29.0
		1800	0.245	140.0	2.12	54.1	0.212	63.6	0.398	- 32.6
		2000	0.263	131.3	1.95	49.9	0.235	62.0	0.397	- 36.2
8	15	100	0.597	- 52.0	22.81	136.3	0.023	69.3	0.774	- 23.9
		300	0.306	- 105.2	10.94	103.8	0.047	66.5	0.484	- 28.5
		500	0.219	- 139.3	6.91	91.3	0.070	68.4	0.405	- 23.3
		800	0.172	- 172.8	4.45	80.0	0.104	69.5	0.390	- 18.3
		1000	0.165	174.6	3.62	74.3	0.128	69.0	0.401	- 19.4
		1200	0.174	164.9	3.09	68.8	0.151	68.1	0.403	- 22.7
		1500	0.201	152.9	2.54	61.0	0.185	66.0	0.388	- 27.8
		1800	0.226	137.5	2.19	53.9	0.219	63.8	0.377	- 31.4
		2000	0.245	128.5	2.01	49.7	0.243	61.8	0.375	- 35.3
8	20	100	0.540	- 56.8	24.86	132.3	0.022	68.6	0.732	- 25.5
		300	0.274	- 110.3	11.22	101.5	0.046	68.6	0.455	- 27.6
		500	0.199	- 144.7	7.03	89.8	0.070	70.5	0.387	- 21.9
		800	0.164	- 177.3	4.49	79.2	0.105	70.9	0.380	- 16.9
		1000	0.160	171.1	3.66	73.5	0.130	70.1	0.391	- 18.2
		1200	0.166	162.3	3.13	68.2	0.153	68.6	0.393	- 21.8
		1500	0.197	151.6	2.58	60.5	0.188	66.2	0.378	- 27.1
		1800	0.223	135.8	2.21	53.7	0.222	63.8	0.367	- 30.9
		2000	0.242	128.2	2.04	49.5	0.246	61.8	0.365	- 34.7
8	25	100	0.502	- 61.1	26.06	129.3	0.021	68.7	0.702	- 26.4
		300	0.254	- 114.6	11.32	99.8	0.045	69.6	0.438	- 26.5
		500	0.191	- 148.9	7.05	88.8	0.070	71.5	0.378	- 20.6
		800	0.162	178.0	4.51	78.5	0.106	71.5	0.374	- 16.0
		1000	0.158	167.6	3.66	73.0	0.131	70.5	0.387	- 17.5
		1200	0.163	159.3	3.13	67.6	0.154	69.0	0.389	- 21.2
		1500	0.200	149.0	2.57	60.1	0.190	66.4	0.374	- 26.6
		1800	0.220	134.7	2.21	53.2	0.224	63.8	0.364	- 30.5
		2000	0.243	128.4	2.04	48.9	0.248	61.7	0.361	- 34.4

### Typical Characteristics

$T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified

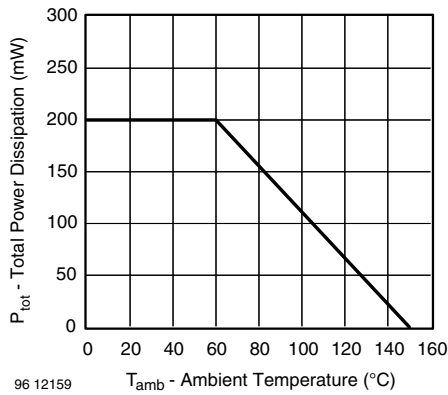


Figure 1. Total Power Dissipation vs. Ambient Temperature

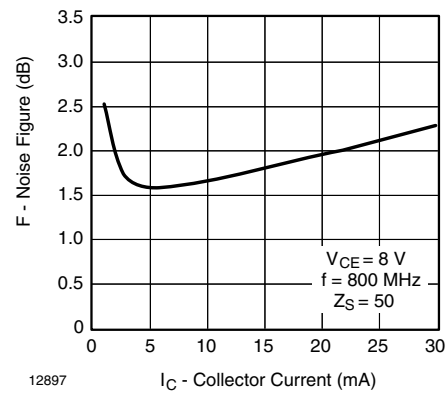


Figure 4. Noise Figure vs. Collector Current

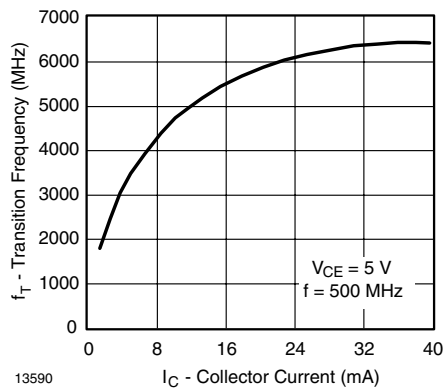


Figure 2. Transition Frequency vs. Collector Current

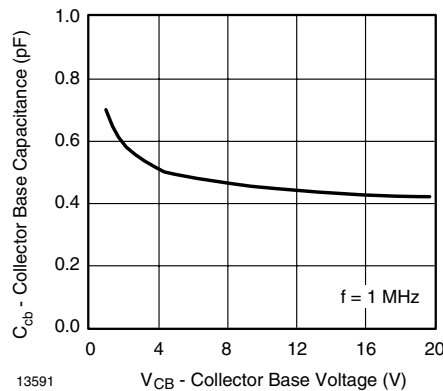
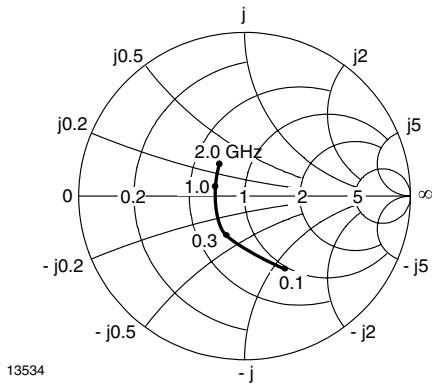


Figure 3. Collector Base Capacitance vs. Collector Base Voltage

$V_{CE} = 8\text{ V}$ ,  $I_C = 25\text{ mA}$ ,  $Z_0 = 50\ \Omega$

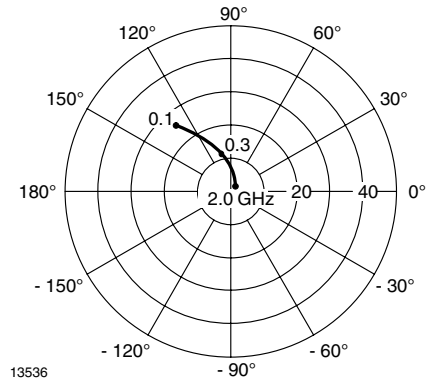
$S_{11}$



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Figure 5. Input Reflection Coefficient

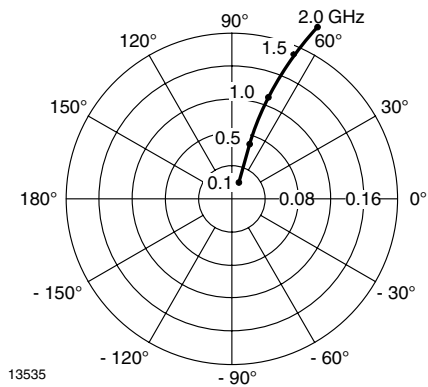
$S_{21}$



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Figure 7. Forward Transmission Coefficient

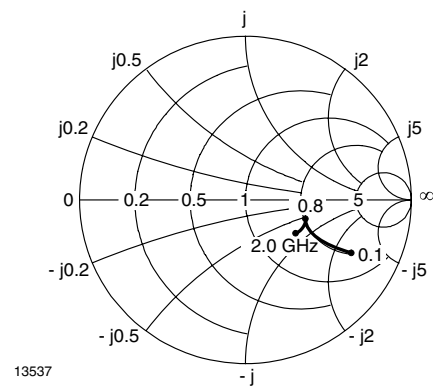
$S_{12}$



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Figure 6. Reverse Transmission Coefficient

$S_{22}$



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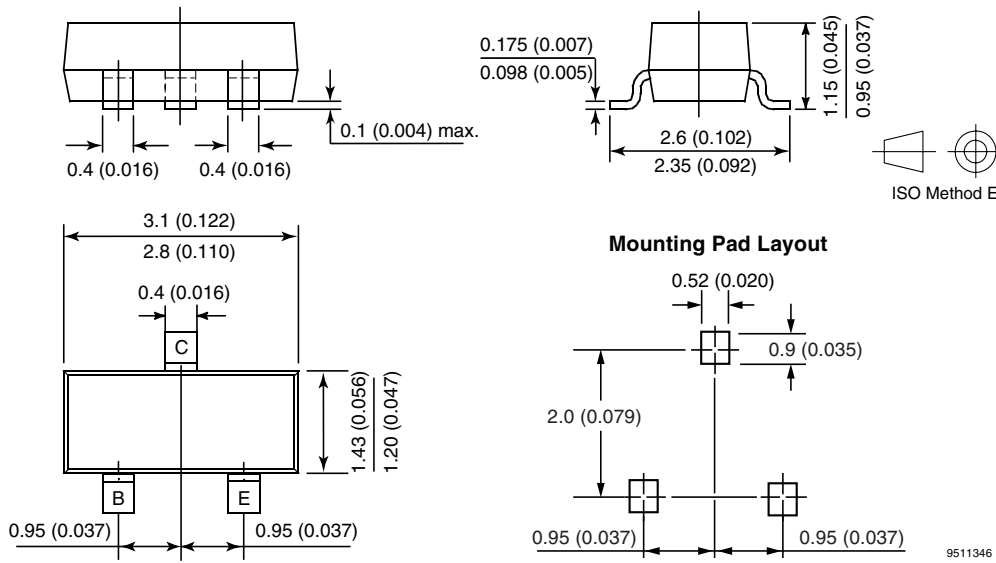
Figure 8. Output Reflection Coefficient

# BFR93A/BFR93AR/BFR93AW

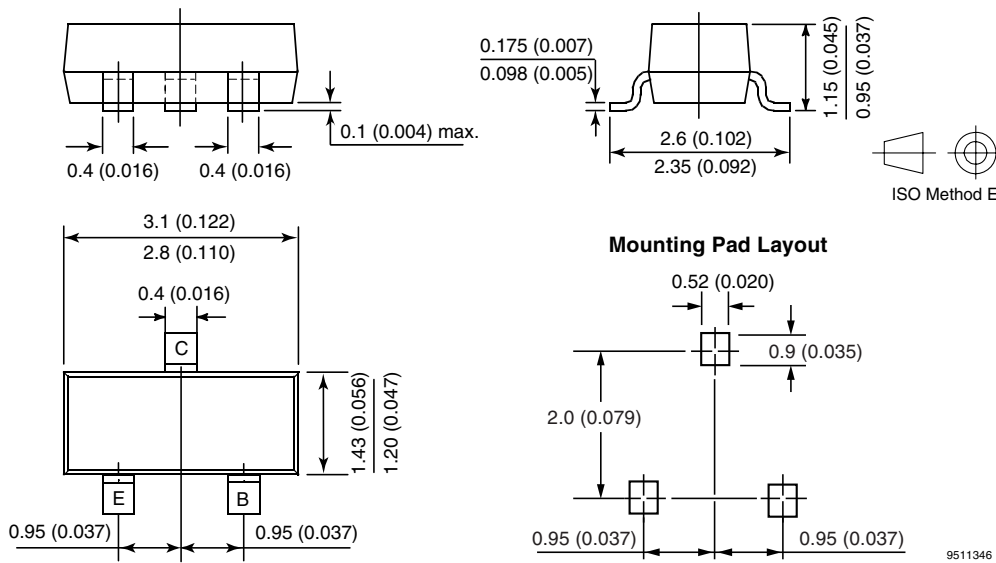


Vishay Semiconductors

## Package Dimensions in mm (Inches): SOT23 (BFR93A)



## Package Dimensions in mm (Inches): SOT23 (BFR93AR)

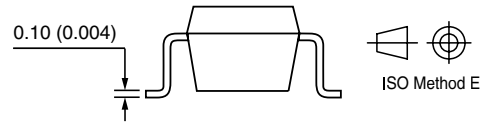
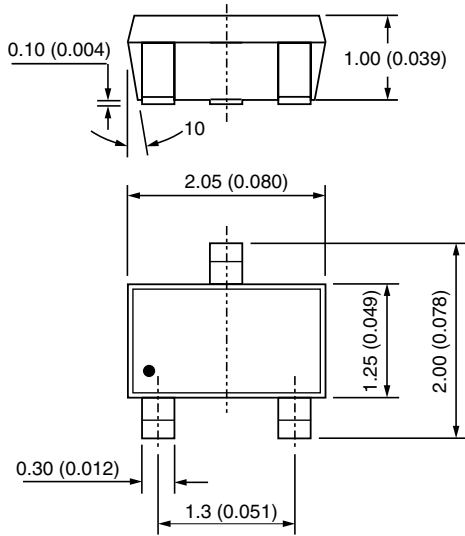




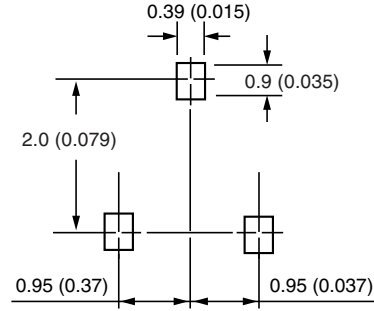
# BFR93A/BFR93AR/BFR93AW

Vishay Semiconductors

## Package Dimensions in mm (Inches): SOT323 (BFR93AW)



Mounting Pad Layout



96 12236

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1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

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1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

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