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# BGA622

Silicon Germanium Wide Band Low Noise  
Amplifier with 2 kV ESD Protection

Small Signal Discretes



Never stop thinking

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**BGA622, Silicon Germanium Wide Band Low Noise Amplifier with 2 kV ESD Protection**

**Revision History: 2008-04-14, Rev. 2.2**

**Previous Version: 2005-11-16**

<b>Page</b>	<b>Subjects (major changes since last revision)</b>
All	Document layout change

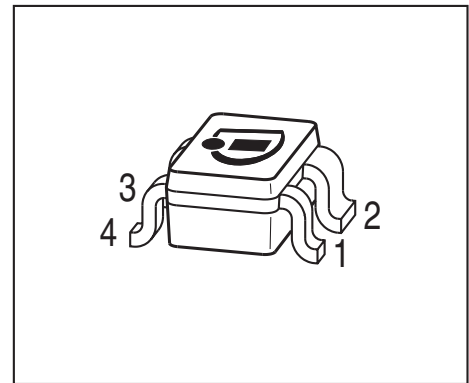
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# 1 Silicon Germanium Wide Band Low Noise Amplifier with 2 kV ESD Protection

## Feature

- High gain
  - $|S_{21}|^2 = 15.0 \text{ dB at } 1.575 \text{ GHz}$
  - $|S_{21}|^2 = 14.2 \text{ dB at } 1.9 \text{ GHz}$
  - $|S_{21}|^2 = 13.6 \text{ dB at } 2.14 \text{ GHz}$
- Low noise figure,  $NF = 1.0 \text{ dB at } 1.575 \text{ GHz}$
- Operating frequency range 0.5 - 6 GHz
- Typical supply voltage: 2.75 V
- On/Off-Switch
- Output-match on chip, input pre-matched
- Low part count
- 70 GHz  $f_T$  - Silicon Germanium technology
- 2 kV HBM ESD protection (Pin-to-Pin)
- Pb-free (RoHS compliant) package



SOT343



## Applications

- LNA for GSM, GPS, DCS, PCS, UMTS, Bluetooth, ISM and WLAN

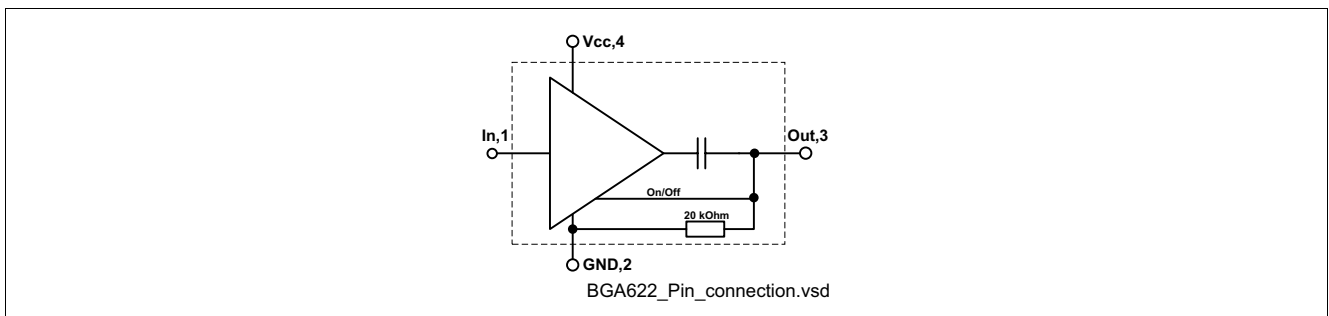


Figure 1 Pin connection

## Description

The BGA622 is a wide band low noise amplifier, based on Infineon Technologies' Silicon Germanium Technology B7HF. In order to provide the LNA in a small package the out-pin is simultaneously used for RF out and On/Off switch. This functionality can be accessed using a RF-Choke at the Out pin, where a DC level of 0 V or an open switches the device on and a DC level of  $V_{CC}$  switches the device off. While the device is switched off, it provides an insertion loss of 24 dB together with a high  $IIP_3$  up to 20 dBm.

Type	Package	Marking
BGA622	SOT343	BXs

Note: **ESD:** Electrostatic discharge sensitive device, observe handling precaution

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**Silicon Germanium Wide Band Low Noise Amplifier with 2 kV ESD Protection**
**Maximum Ratings**
**Table 1 Maximum ratings**

Parameter	Symbol	Limit Value	Unit
Voltage at pin $V_{CC}$	$V_{CC}$	3.5	V
Voltage at pin Out	$V_{out}$	4	V
Current into pin In	$I_{in}$	0.1	mA
Current into pin Out	$I_{out}$	1	mA
Current into pin $V_{CC}$	$I_{VCC}$	10	mA
RF input power	$P_{in}$	6	dBm
Total power dissipation, $T_S < 139\text{ °C}^{1)}$	$P_{tot}$	35	mW
Junction temperature	$T_J$	150	°C
Ambient temperature range	$T_A$	-65... 150	°C
Storage temperature range	$T_{STG}$	-65... 150	°C
ESD capability all pins (HBM: JESD22-A114)	$V_{ESD}$	2000	V

1)  $T_S$  is measured on the ground lead at the soldering point

*Note: All Voltages refer to GND-Node*

**Thermal resistance**
**Table 2 Thermal resistance**

Parameter	Symbol	Value	Unit
Junction - soldering point <sup>1)</sup>	$R_{thJS}$	300	K/W

1) For calculation of  $R_{thJA}$  please refer to Application Note Thermal Resistance

## 2 Electrical Characteristics

### 2.1 Electrical characteristics at $T_A = 25\text{ °C}$ (measured according to [Figure 2](#)) $V_{CC} = 2.75\text{ V}$ , Frequency = 1.575 GHz, unless otherwise specified

**Table 3 Electrical Characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Insertion power gain	$ S_{21} ^2$		15.0		dB	
Insertion power gain (Off-State)	$ S_{21} ^2$		-27		dB	
Input return loss (On-State)	$RL_{in}$		5		dB	
Output return loss (On-State)	$RL_{out}$		12		dB	
Noise figure ( $Z_S = 50\ \Omega$ )	$F_{50\Omega}$		1.00		dB	$f = 0.1\text{ GHz}$
Input third order intercept point <sup>1)</sup> (On-State)	$IIP_3$		0		dBm	$\Delta f = 1\text{ MHz}$ , $P_{IN} = -28\text{ dBm}$
Input third order intercept point <sup>1)</sup> (Off - State)	$IIP_3$		20		dBm	$\Delta f = 1\text{ MHz}$ , $P_{IN} = -8\text{ dBm}$
Input power at 1 dB gain compression	$P_{-1dB}$		-16.5		dBm	
Total device off current	$I_{tot-off}$	130	260	420	$\mu\text{A}$	$V_{CC} = 2.75\text{ V}$ , $V_{out} = V_{CC}$
Total device on current	$I_{tot-on}$	4.0	5.8	7.8	mA	$V_{CC} = 2.75\text{ V}$
On / Off switch control voltage	$V_{on}$	0		0.8	V	$V_{CC} = 2.75\text{ V}$ ON-Mode: $V_{out} = V_{on}$
	$V_{off}$	2.0		3.5	V	$V_{CC} = 2.75\text{ V}$ OFF-Mode: $V_{out} = V_{off}$

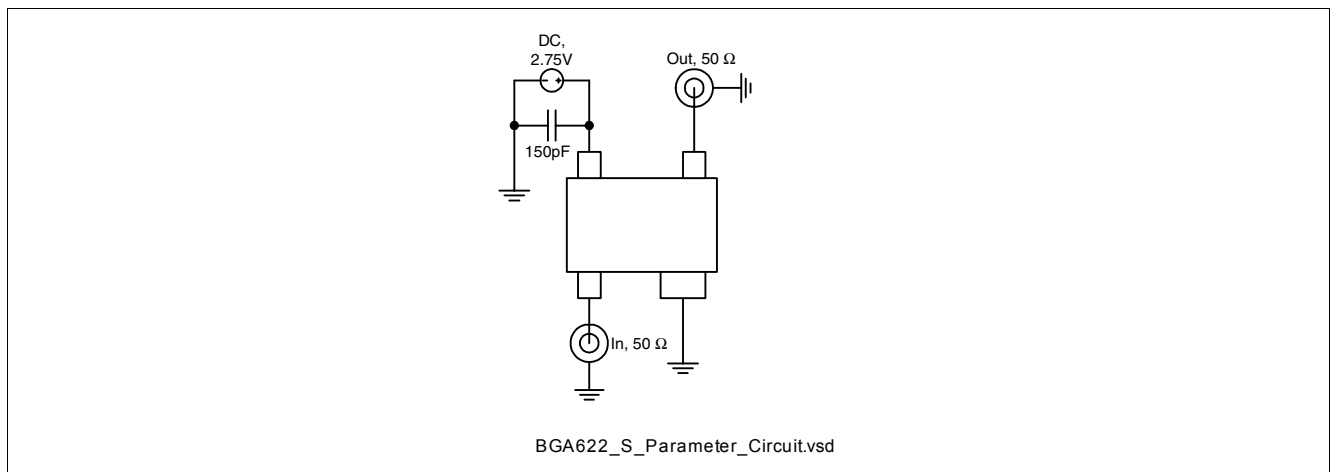
1)  $IP_3$  values depends on termination of all intermodulation frequency components. Termination used for this measurement is 50  $\Omega$  from 0.1 to 6 GHz

**2.2 Electrical characteristics at  $T_A = 25\text{ °C}$  (measured according to [Figure 2](#))  
 $V_{CC} = 2.75\text{ V}$ , Frequency = 2.14 GHz, unless otherwise specified**

**Table 4 Electrical Characteristics**

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Insertion power gain	$ S_{21} ^2$		13.6		dB	
Insertion power gain (Off-State)	$ S_{21} ^2$		-24		dB	
Input return loss (On-State)	$RL_{in}$		7		dB	
Output return loss (On-State)	$RL_{out}$		10		dB	
Noise figure ( $Z_S = 50\ \Omega$ )	$F_{50\Omega}$		1.05		dB	
Input third order intercept Point <sup>1)</sup> (On-State)	$IIP_3$		3		dBm	$\Delta f = 1\text{ MHz}$ , $P_{IN} = -28\text{ dBm}$
Input third order intercept point <sup>1)</sup> (Off-State)	$IIP_3$		20		dBm	$\Delta f = 1\text{ MHz}$ , $P_{IN} = -8\text{ dBm}$
Input power at 1 dB gain compression	$P_{-1dB}$		-13		dBm	

1)  $IP_3$  values depends on termination of all intermodulation frequency components. Termination used for this measurement is 50  $\Omega$  from 0.1 to 6 GHz



**Figure 2 S-Parameter Test Circuit (loss-free microstrip test-fixture)**



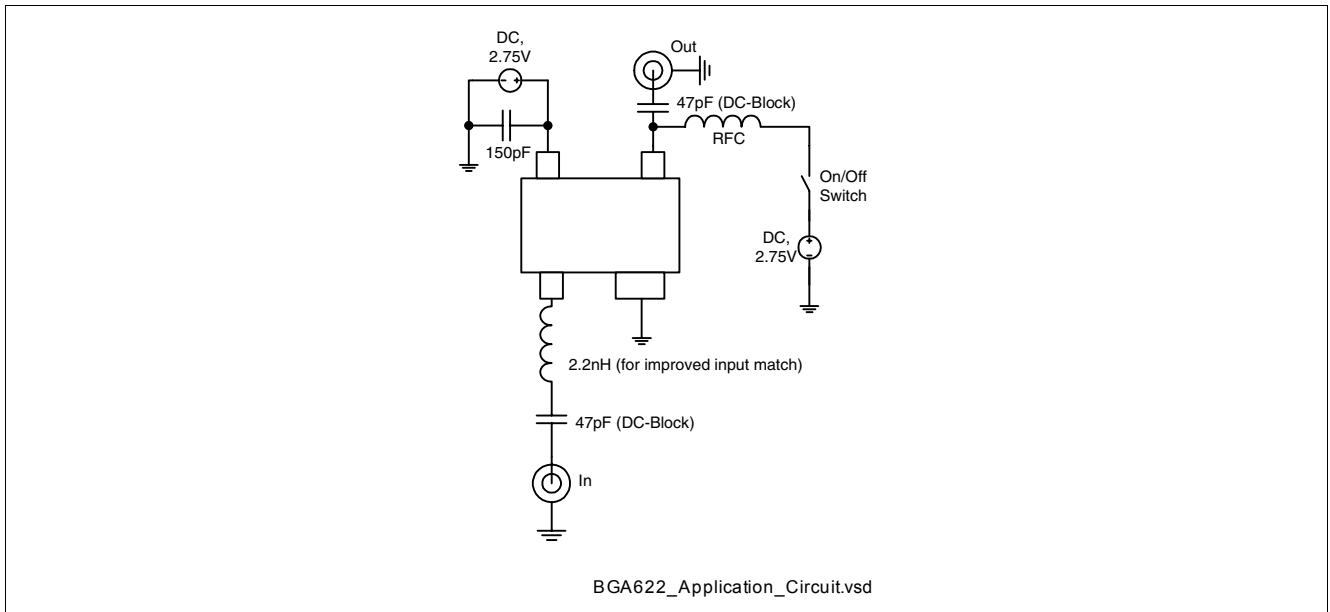
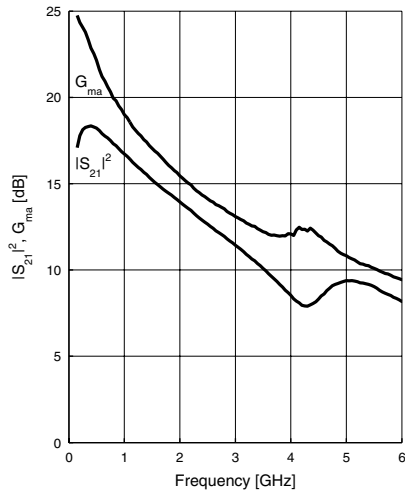


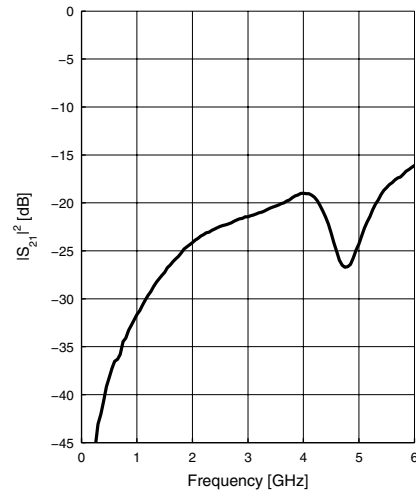
Figure 3 Application Circuit for 1800 - 2500 MHz

### 3 Measured Parameters

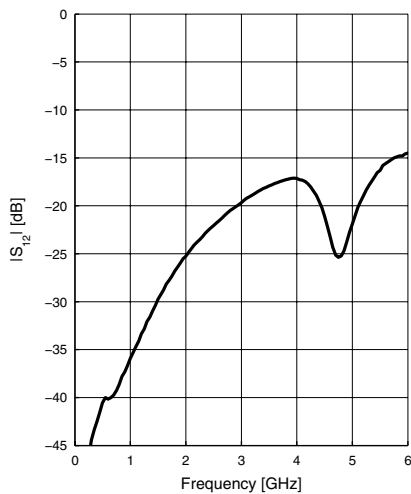
**Power Gain**  $|S_{21}|^2, G_{ma} = f(f)$   
 $V_{CC} = 2.75V, I_{tot-on} = 5.8mA$



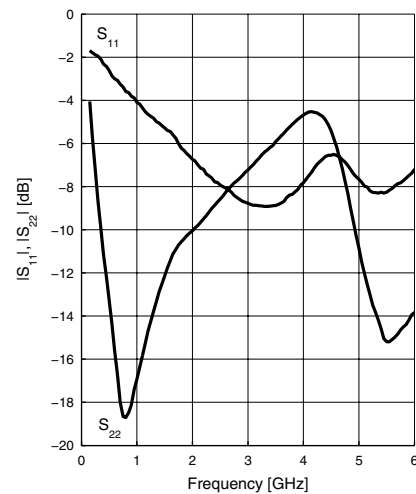
**Off Gain**  $|S_{21}|^2 = f(f)$   
 $V_{CC} = 2.75V, V_{OUT} = 2.75V, I_{tot-off} = 0.3mA$



**Reverse Isolation**  $|S_{12}| = f(f)$   
 $V_{CC} = 2.75V, I_{tot-on} = 5.8mA$



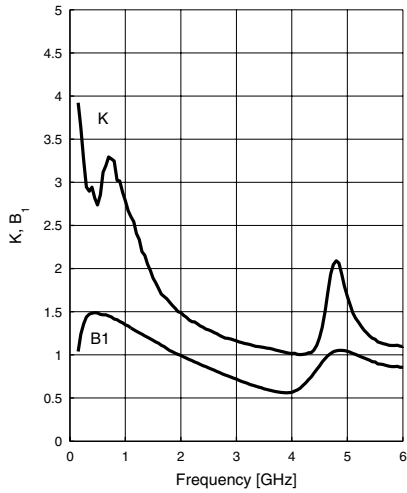
**Matching**  $|S_{11}|, |S_{22}| = f(f)$   
 $V_{CC} = 2.75V, I_{tot-on} = 5.8mA$



Measured Parameters

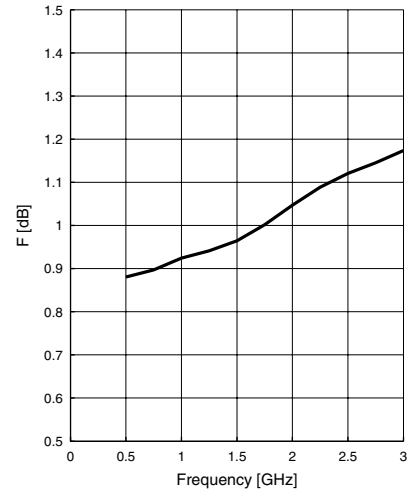
**Stability K, B<sub>1</sub> = f(f)**

V<sub>CC</sub> = 2.75V, I<sub>tot-on</sub> = 5.8mA



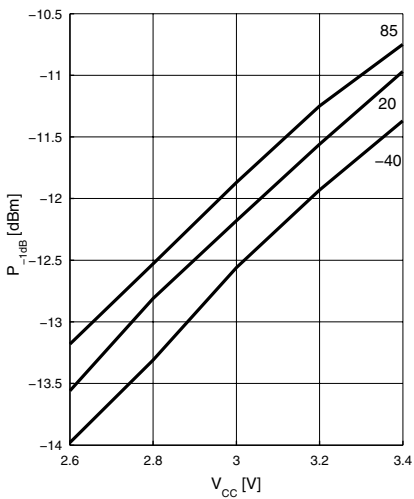
**Noise Figure F = f(f)**

V<sub>CC</sub> = 2.75V, I<sub>tot-on</sub> = 5.8mA, Z<sub>S</sub> = 50Ω



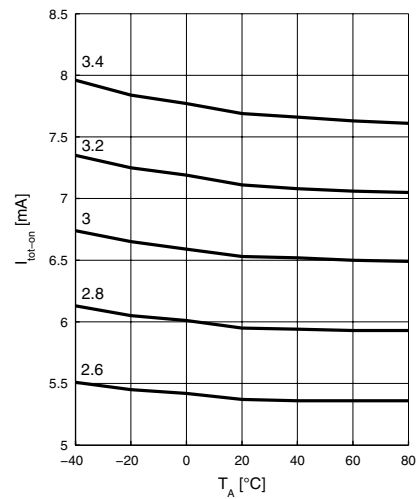
**Input Compression Point P<sub>-1dB</sub> = f(V<sub>CC</sub>)**

f = 2.14GHz, T<sub>A</sub> = parameter in °C

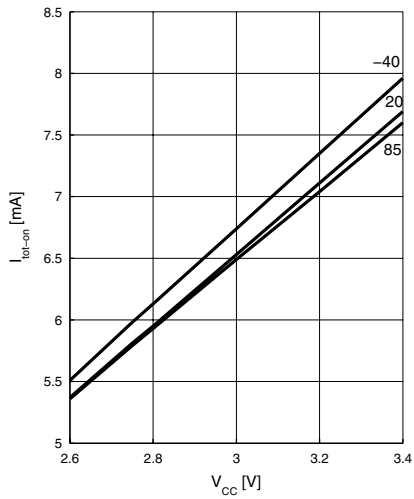


**Device Current I<sub>tot-on</sub> = f(T<sub>A</sub>, V<sub>CC</sub>)**

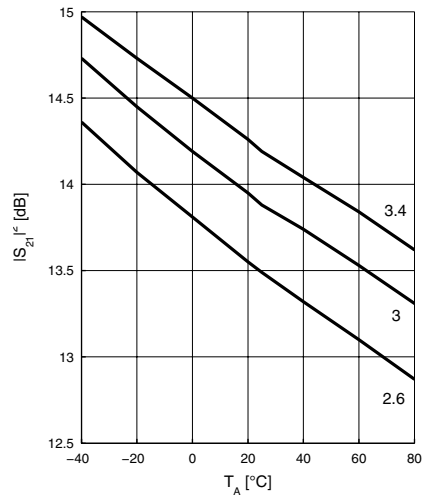
V<sub>CC</sub> = parameter in V



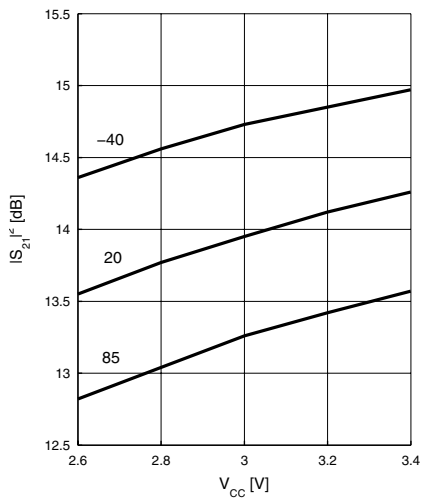
**Device Current**  $I_{\text{tot-on}} = f(V_{\text{CC}}, T_A)$   
 $T_A$  = parameter in °C



**Power Gain**  $|S_{21}|^2 = f(T_A, V_{\text{CC}})$   
 $f = 2.14\text{GHz}$ ,  $V_{\text{CC}}$  = parameter in V



**Power Gain**  $|S_{21}|^2 = f(V_{\text{CC}}, T_A)$   
 $f = 2.14\text{GHz}$ ,  $T_A$  = parameter in °C



## 4 Package Information

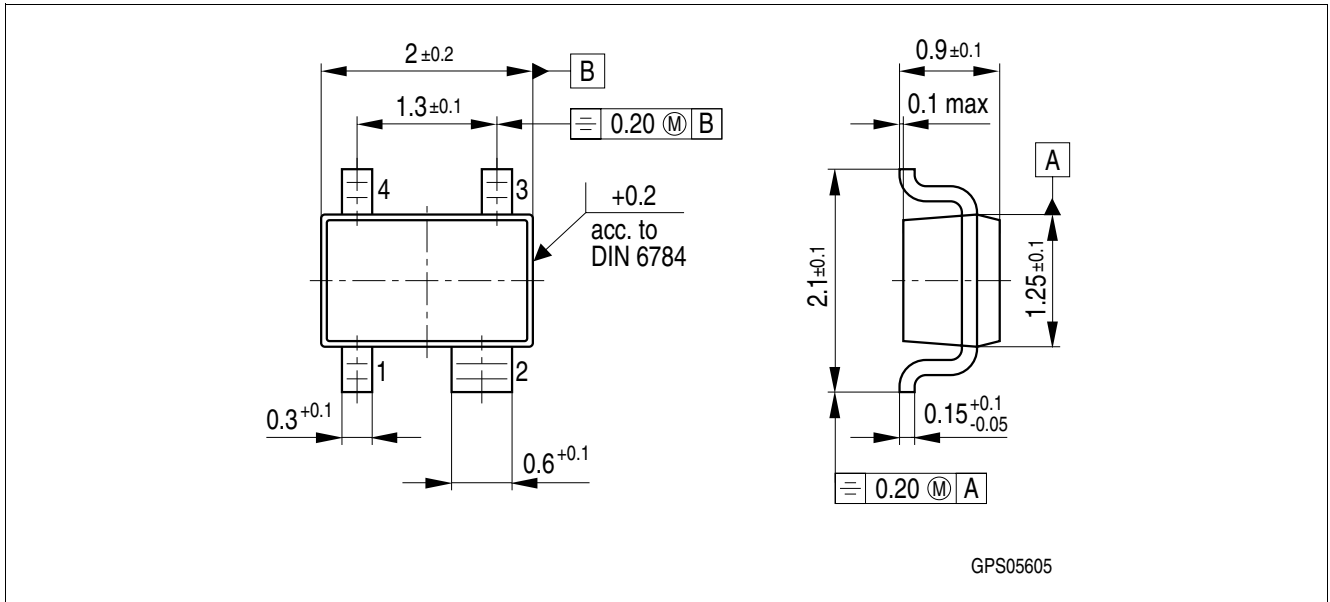


Figure 4 Package Outline SOT343

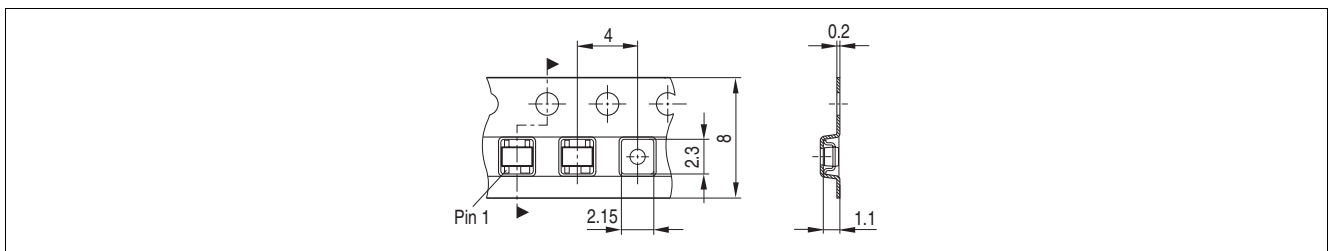


Figure 5 Tape for SOT343