

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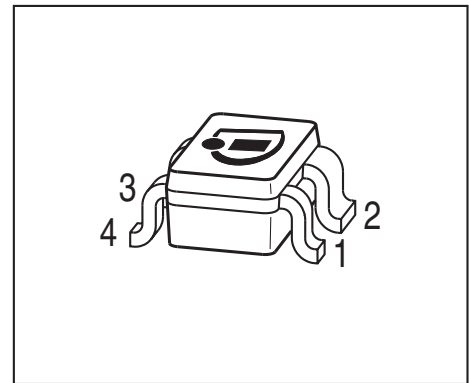
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# 1 Silicon Germanium Wide Band Low Noise Amplifier with 2 kV ESD Protection

## 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

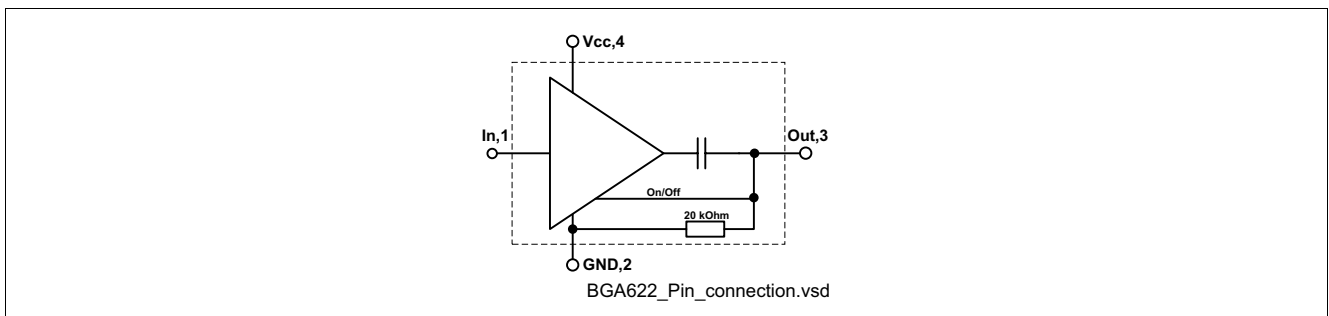


Figure 1 Pin connection

## 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           | $\Delta f = 1\text{ MHz}$ ,<br>$P_{IN} = -28\text{ dBm}$     |
| Input third order intercept point <sup>1)</sup> (Off - State) | $IIP_3$        |        | 20    |      | dBm           | $\Delta f = 1\text{ MHz}$ ,<br>$P_{IN} = -8\text{ dBm}$      |
| Input power at 1 dB gain compression                          | $P_{-1dB}$     |        | -16.5 |      | dBm           |                                                              |
| Total device off current                                      | $I_{tot-off}$  | 130    | 260   | 420  | $\mu\text{A}$ | $V_{CC} = 2.75\text{ V}$ ,<br>$V_{out} = V_{CC}$             |
| 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             | $V_{CC} = 2.75\text{ V}$<br>ON-Mode:<br>$V_{out} = V_{on}$   |
|                                                               | $V_{off}$      | 2.0    |       | 3.5  | V             | $V_{CC} = 2.75\text{ V}$<br>OFF-Mode:<br>$V_{out} = V_{off}$ |

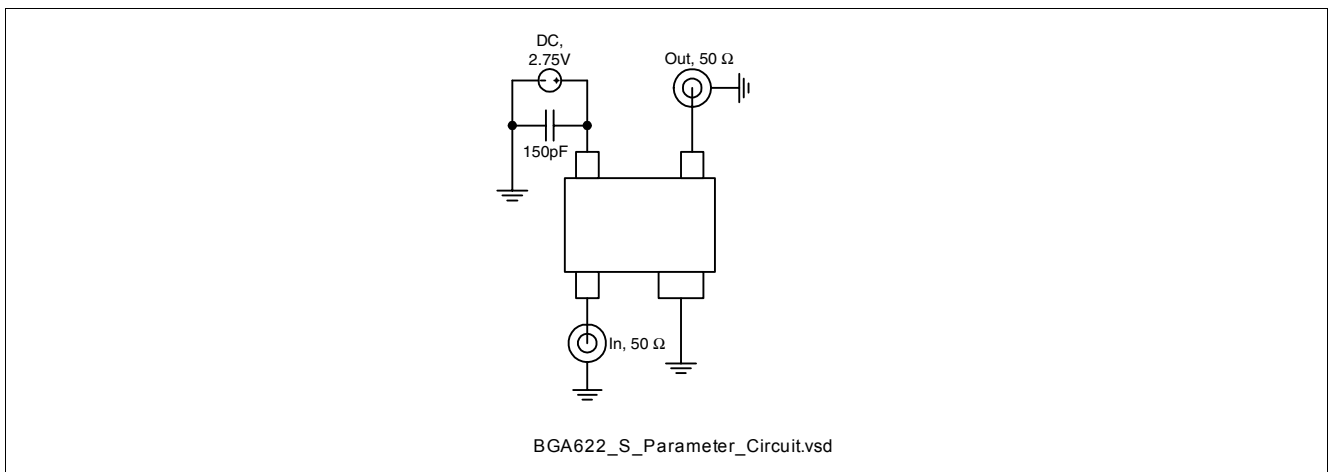
1)  $IP_3$  values depends on termination of all intermodulation frequency components. Termination used for this measurement is 50  $\Omega$  from 0.1 to 6 GHz

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

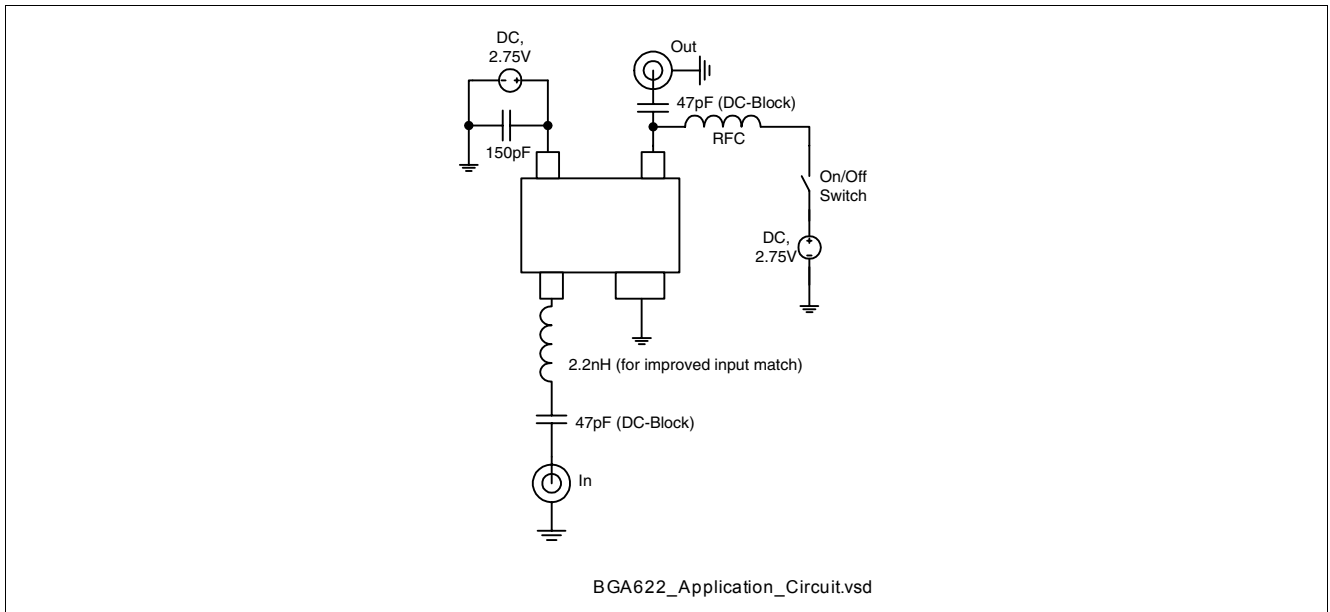
**Table 4 Electrical Characteristics**

| 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  | $\Delta f = 1\text{ MHz}$ ,<br>$P_{IN} = -28\text{ dBm}$ |
| Input third order intercept point <sup>1)</sup> (Off-State) | $IIP_3$        |        | 20   |      | dBm  | $\Delta f = 1\text{ MHz}$ ,<br>$P_{IN} = -8\text{ dBm}$  |
| 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)**

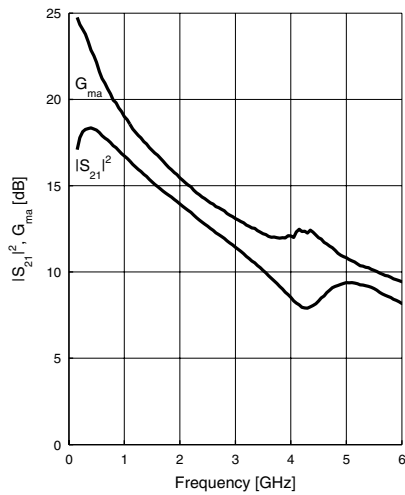


**Figure 3** Application Circuit for 1800 - 2500 MHz

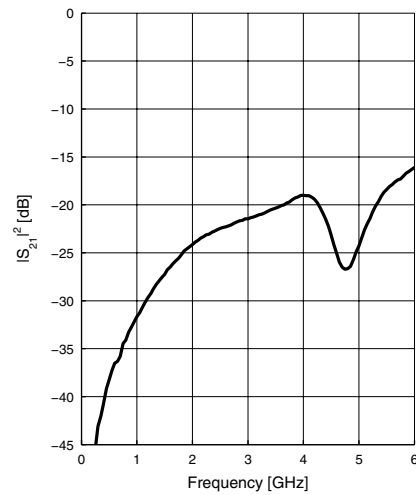


### 3 Measured Parameters

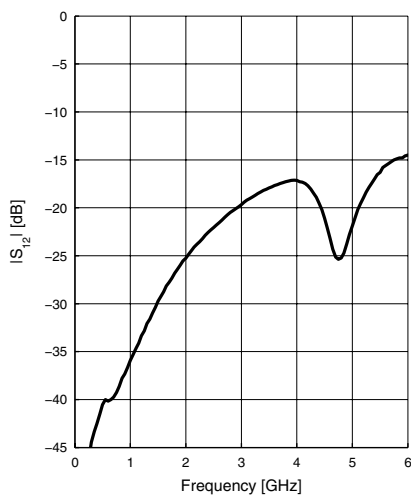
**Power Gain**  $|S_{21}|^2, G_{ma} = f(f)$   
 $V_{CC} = 2.75V, I_{tot-on} = 5.8mA$



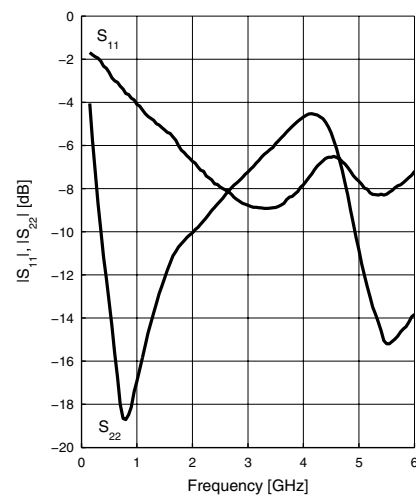
**Off Gain**  $|S_{21}|^2 = f(f)$   
 $V_{CC} = 2.75V, V_{OUT} = 2.75V, I_{tot-off} = 0.3mA$



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

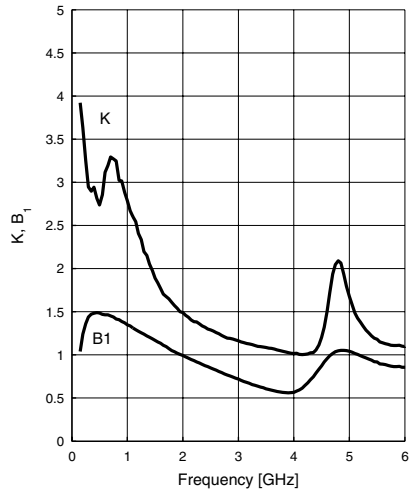


**Matching**  $|S_{11}|, |S_{22}| = f(f)$   
 $V_{CC} = 2.75V, I_{tot-on} = 5.8mA$



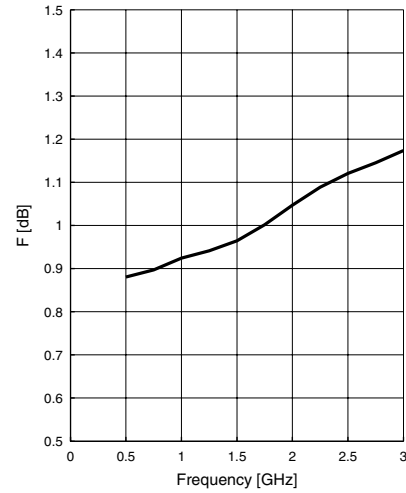
**Stability K, B<sub>1</sub> = f(f)**

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



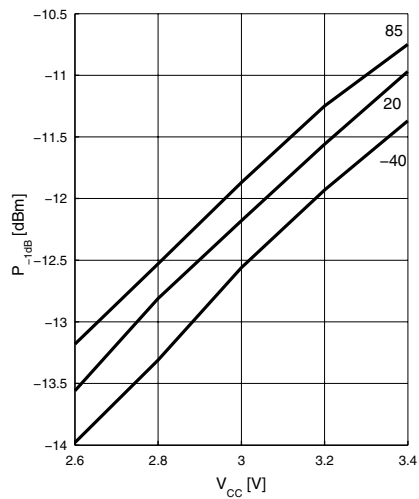
**Noise Figure F = f(f)**

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



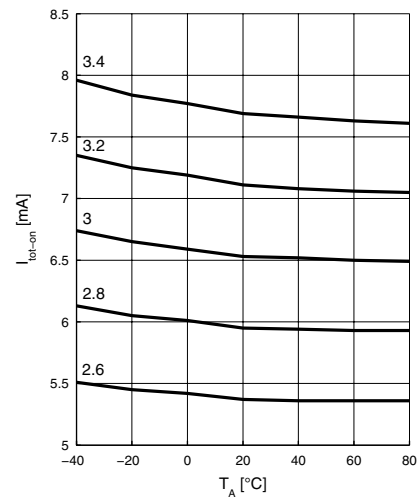
**Input Compression Point P<sub>-1dB</sub> = f(V<sub>CC</sub>)**

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

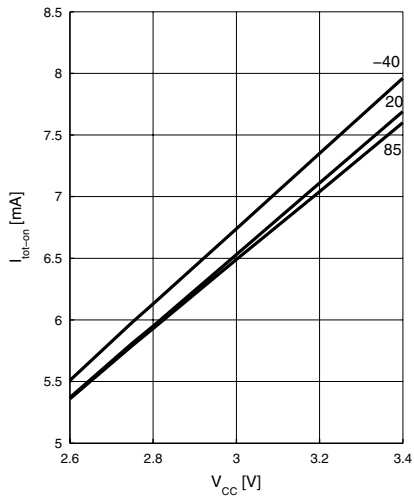


**Device Current I<sub>tot-on</sub> = f(T<sub>A</sub>, V<sub>CC</sub>)**

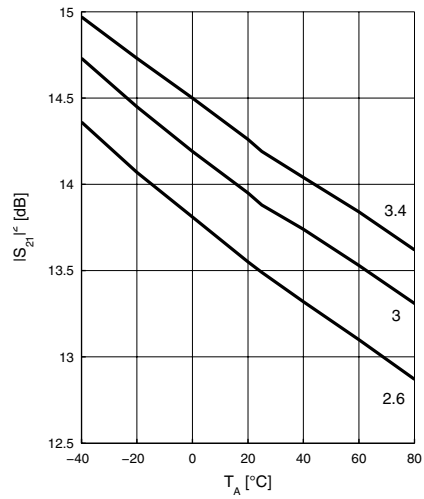
V<sub>CC</sub> = parameter in V



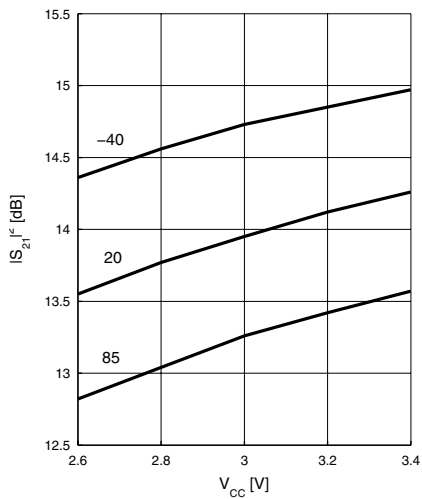
**Device Current**  $I_{\text{tot-on}} = f(V_{\text{CC}}, T_A)$   
 $T_A$  = parameter in °C



**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

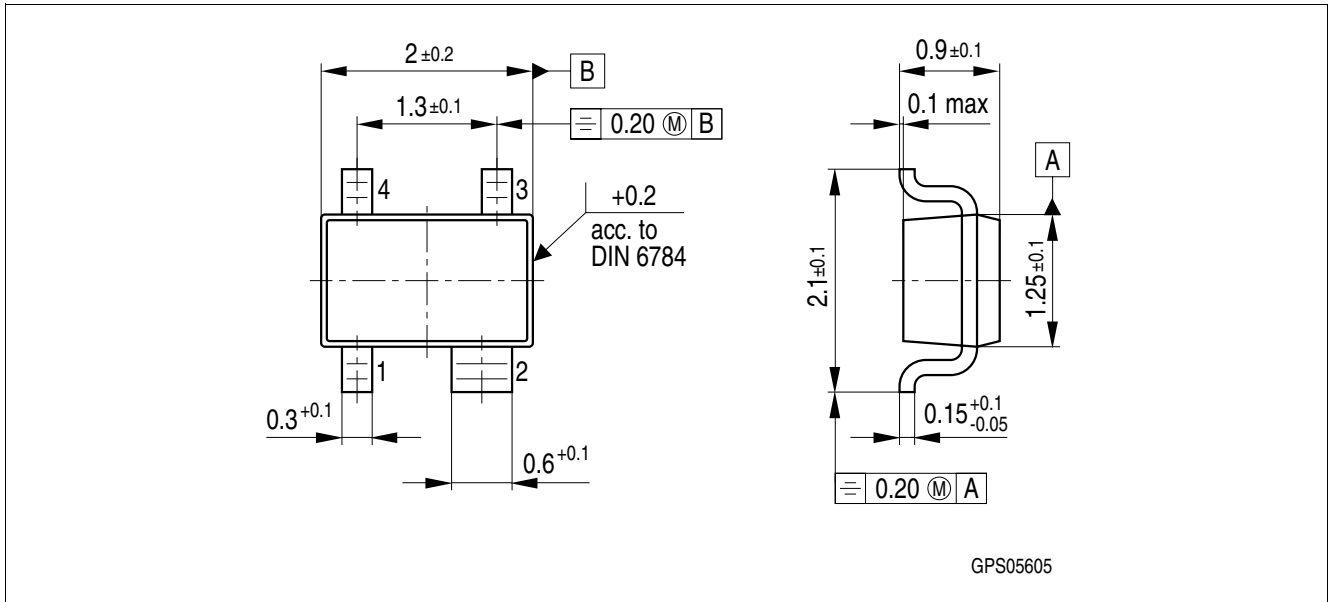


Figure 4 Package Outline SOT343

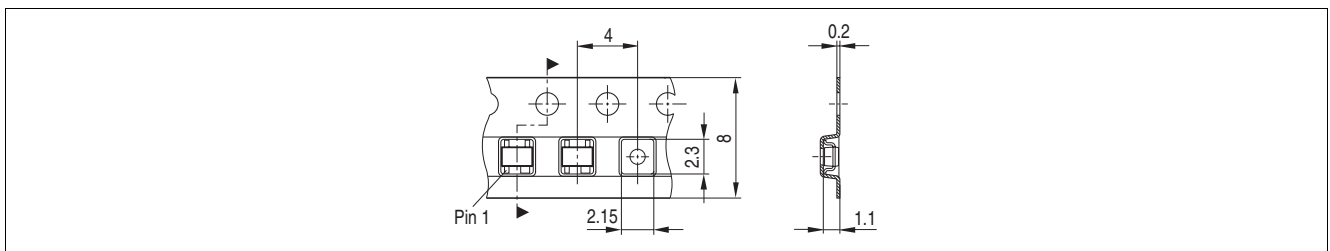


Figure 5 Tape for SOT343