# BGB741L7ESD

## ESD-Robust and Easy-To-Use Broadband LNA MMIC

RF & Protection Devices

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Prevision History: no previous version

| Page | Subjects (major changes since last revision) |
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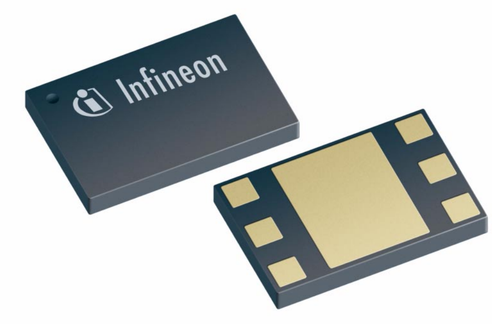
# 1 ESD-Robust and Easy-To-Use Broadband LNA MMIC

**Features**

- High-performance broadband LNA MMIC for applications between 50 MHz and 5.5 GHz
- Integrated stabilization, biasing, matching and ESD-protection simplifies design and reduces external parts count
- Integrated active biasing circuit makes operation point highly stable against temperature- and processing-variations
- Integrated ESD protection: RF input pin typical 4 kV vs. GND, RF output pin 2.5 kV vs. GND (HBM stress pulses)
- Supply voltage 1.8 - 4.0 V
- Adjustable current 6 mA to 30 mA by an external resistor
- Power-off function
- Excellent noise figure for a broadband LNA by using latest SiGe:C bipolar technolgy
- High linearity due to active biasing
- Very small, leadless, Pb-free (RoHS compliant) and halogen-free (WEEE compliant) “green” package TSLP-7-1, 2.0 x 1.3 x 0.4 mm




**Applications**

- Mobile TV, DAB, RKE, AMR, Cellular, ZigBee, WiMAX, SDARs, WiFi, Cordless phone, UMTS, WLAN, UWB

# 2 Product Brief

The BGB741L7ESD is an advanced high performance low noise amplifier (LNA) MMIC which simplifies the design of arbitrary LNA application circuits. Due to its integrated feedback the device is perfectly matched up to 3.5 GHz. The integrated biasing further reduces external parts count and stabilizes the bias current against temperature- and process-variations. The integrated feedback provides unconditional stability and eases the design process. The device is highly flexible because the bias current is adjustable and the device works with a broad supply voltage range. The BGB741L7ESD is based upon Infineon Techologies’ cost effective bipolar silicon germanium carbon (SiGe:C) technology and comes in a low profile TSLP-7-1 leadless “green” package.

| Type | Package | Marking |
|---|---|---|
| BGB741L7ESD | TSLP-7-1 | AY |

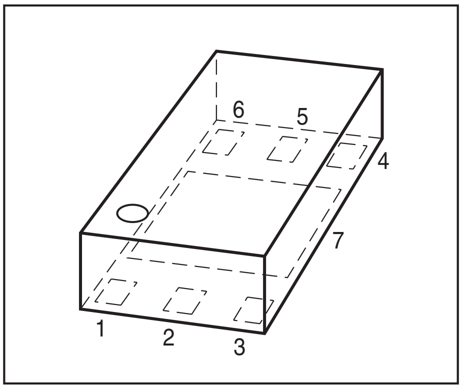



**Figure 1 Pin configuration**

**Table 1 Pinning table**

| Pin | Function |
|---|---|
| 1 | $V_{CC}$ |
| 2 | Bias-Out |
| 3 | RF-In |
| 4 | RF-Out |
| 5 | Control On/Off |
| 6 | Current Adjust |
| 7 | GND |

The following diagram shows the principal schematic how the BGB741L7ESD is used in a circuit. The Power On/Off function is used by applying $V_{ctrl}$. By applying an external resistor $R_{ext}$ the pre-set current of 6mA (which is adjusted by the integrated biasing when $R_{ext}$ is omitted) can be increased. Base- and collector voltages are applied to the respective RFin- and RFout-pins by external inductors.

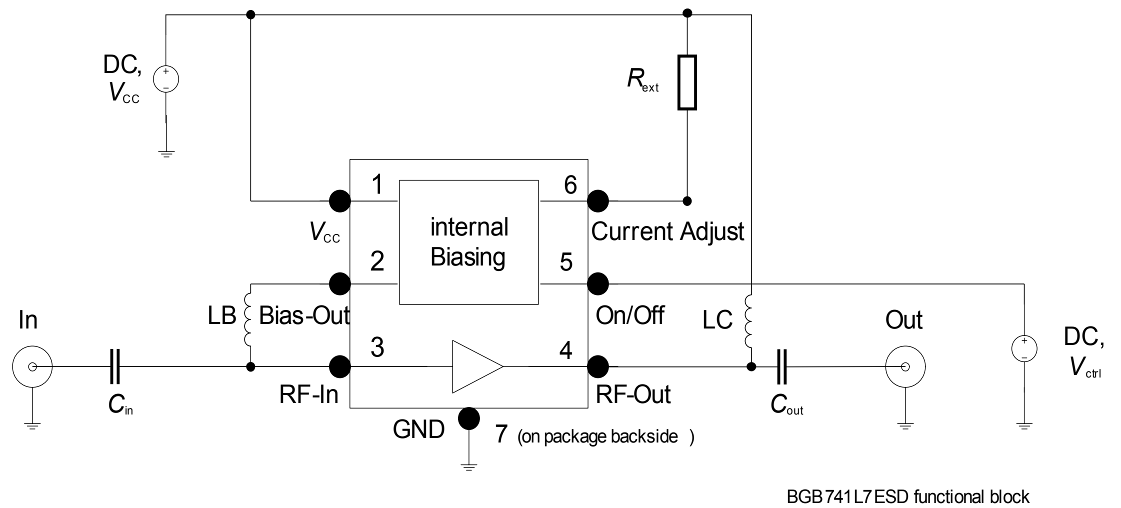



**Figure 2 Functional block diagram**

# 3 Maximum Ratings

**Table 2 Maximum ratings at $T_A$ = 25°C (unless otherwise specified)**

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Supply voltage<br>$T_A$ = -55°C | $V_{CC}$ | 4.0<br>3.5 | V |
| Supply current at $V_{CC}$ pin | $I_{CC}$ | 30 | mA |
| DC current at RF In pin | $I_B$ | 3 | mA |
| Voltage at Control On / Off pin | $V_{ctrl}$ | 4.0 | V |
| Total power dissipation[1)]<br>$T_S$<117°C | $P_{tot}$ | 120 | mW |
| Operation junction temperature | $T_{JOp}$ | -55...150 | °C |
| Storage temperature | $T_{Stg}$ | -55...150 | °C |

1) The soldering point temperature $T_S$ measured at the GND pin (7) at the soldering point to the pcb

*Note: Exceeding only one of the above maximum rating limits even for a short moment may cause permanent damage to the device. Even if the device continues to operate, its lifetime may be considerably shortened. Maximum ratings are stress ratings only and do not mean unaffected functional operation and lifetime at others than standard operation conditions.*

# 4 Thermal Characteristics

**Table 3 Thermal Resistance**

| Parameter | Symbol | Value | Unit |
|---|---|---|---|
| Junction - soldering point[1)] | $R_{thJS}$ | 275 | K/W |

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

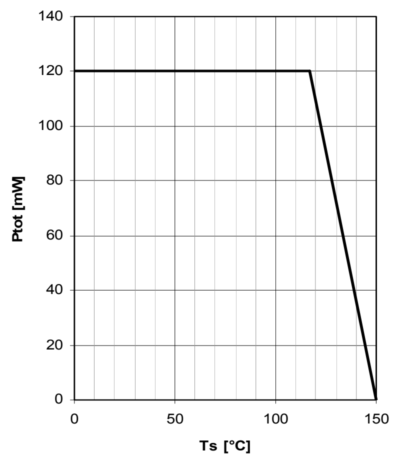



**Figure 3 Maximum total Power Dissipation $P_{tot}$ as function of temperature $T_S$ at soldering point**

# 5 Operation Conditions

**Table 4 Operation Conditions**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Supply voltage | $V_{CC}$ | 1.8 | 3.0 | 4.0 | V | |
| Voltage Control On/Off pin in On mode | $V_{ctrl\text{-}on}$ | 1.2 | | 4.0 | V | |
| Voltage Control On/Off pin in Off mode | $V_{ctrl\text{-}off}$ | -0.3 | | 0.3 | V | |

# 6 Electrical Characteristics

## 6.1 DC Characteristics

**Table 5 DC characteristics at $T_A$ = 25 °C**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Supply current in On-mode | $I_{CC}$ | 5.0 | 6.0<br>10 | 7.2 | mA | $R_{ext}$ = open<br>$R_{ext}$ = 4 kΩ<br>$V_{CC}$ = 3.0 V<br>$V_{ctrl}$ = 3.0 V<br>(Small signal operation) |
| Supply current in Off mode | $I_{CC\text{-}off}$ | | | 6.0 | µA | $V_{CC}$ = 3.0 V<br>$V_{ctrl}$ = 0 V |
| Current into Control On/Off pin in On-mode | $I_{ctrl\text{-}on}$ | | 14 | 20 | µA | $V_{CC}$ = 3.0 V<br>$V_{ctrl}$ = 3.0 V |
| Current into Control On/Off pin in Off-mode | $I_{ctrl\text{-}off}$ | | | 0.1 | µA | $V_{CC}$ = 3.0 V<br>$V_{ctrl}$ = 0 V |

## 6.2 AC Characteristics

The measurement setup is a test fixture with Bias-T's in a 50 Ω system, $T_A$ = 25 °C.

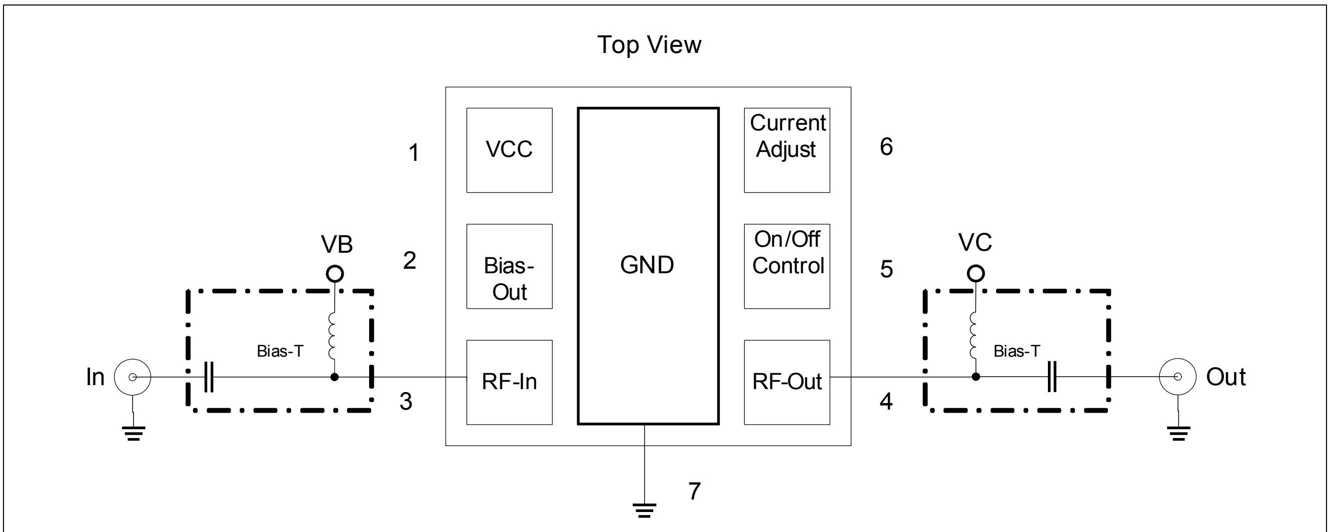



**Figure 4 BGB741L7ESD testing setup**

**Table 6 AC Characteristics, $V_C$ = 3 V, $f$ = 150 MHz**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Minimum Noise Figure[1] | $NF_{min}$ | | <br>1.05<br>0.95 | | dB | $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Noise Figure in 50Ω System[2] | $NF_{50}$ | | <br>1.1<br>1.05 | | dB | $Z_S = Z_L$ = 50Ω<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Transducer Gain | $\|S_{21}\|^2$ | | 19<br>21 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Maximum Stable Power Gain | $G_{ms}$ | | <br>20<br>21.5 | | dB | $Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Input 1 dB Gain compression point[3] | $IP_{1dB}$ | | -5.5<br>-8 | | dBm | $I_{Cq}$ = 6 mA<br>$I_{Cq}$ = 10 mA |
| Input 3rd Order Intercept Point | $IIP_3$ | | 5.5<br>3.5 | | dBm | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Input Return Loss | $R.L._{in}$ | | 14<br>18 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Output Return Loss | $R.L._{out}$ | | 12.5<br>18.5 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |

1) Test fixture losses extracted
2) Test fixture losses extracted
3) Measured on an application board according to figure 2) presenting roughly a 50 Ω system to the device. $I_{Cq}$ is the quiescent current, that is at small RF input power level. $I_C$ increases as RF input power level approaches P1dB.

**Table 7 AC Characteristics, $V_C$ = 3 V, $f$ = 450 MHz**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Minimum Noise Figure[1] | $NF_{min}$ | | <br>1.05<br>0.95 | | dB | $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Noise Figure in 50Ω System[2] | $NF_{50}$ | | <br>1.1<br>1.05 | | dB | $Z_S = Z_L = 50\Omega$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Transducer Gain | $\|S_{21}\|^2$ | | 18.5<br>20.5 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Maximum Available Power Gain | $G_{ma}$ | | <br>19<br>20.5 | | dB | $Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Input 1 dB Gain compression point[3] | $IP_{1dB}$ | | -5<br>-7.5 | | dBm | $I_{Cq}$ = 6 mA<br>$I_{Cq}$ = 10 mA |
| Input 3rd Order Intercept Point | $IIP_3$ | | 4<br>2.5 | | dBm | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Input Return Loss | $R.L._{in}$ | | 15.5<br>21 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Output Return Loss | $R.L._{out}$ | | 14.5<br>28 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |

1) Test fixture losses extracted
2) Test fixture losses extracted
3) Measured on an application board according to figure 2) presenting roughly a 50 Ω system to the device. $I_{Cq}$ is the quiescent current, that is at small RF input power level. $I_C$ increases as RF input power level approaches P1dB.

**Table 8 AC Characteristics, $V_C$ = 3 V, $f$ = 900 MHz**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Minimum Noise Figure[1] | $NF_{min}$ | | <br>1.05<br>0.95 | | dB | $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Noise Figure in 50Ω System[2] | $NF_{50}$ | | <br>1.1<br>1.05 | | dB | $Z_S = Z_L = 50\Omega$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Transducer Gain | $\|S_{21}\|^2$ | | 18.5<br>20 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Maximum Available Power Gain | $G_{ma}$ | | <br>19<br>20.5 | | dB | $Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Input 1 dB Gain compression point[3] | $IP_{1dB}$ | | -5<br>-7 | | dBm | $I_{Cq}$ = 6 mA<br>$I_{Cq}$ = 10 mA |
| Input 3rd Order Intercept Point | $IIP_3$ | | 3<br>1.5 | | dBm | $I_C$ = 6 mA<br>$I_C$ = 10 mA |

**Table 8 AC Characteristics, $V_C$ = 3 V, (cont'd) $f$ = 900 MHz**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input Return Loss | $R.L._{in}$ | | 15.5<br>19 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Output Return Loss | $R.L._{out}$ | | 14.5<br>28.5 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |

1) Test fixture losses extracted
2) Test fixture losses extracted
3) Measured on an application board according to figure 2) presenting roughly a 50 Ω system to the device. $I_{Cq}$ is the quiescent current, that is at small RF input power level. $I_C$ increases as RF input power level approaches P1dB.

**Table 9 AC Characteristics, $V_C$ = 3 V, $f$ = 1500 MHz**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Minimum Noise Figure[1] | $NF_{min}$ | | <br>1.05<br>1.0 | | dB | $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Noise Figure in 50Ω System[2] | $NF_{50}$ | | <br>1.1<br>1.05 | | dB | $Z_S = Z_L$ = 50Ω<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Transducer Gain | $\|S_{21}\|^2$ | | 18<br>19.5 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Maximum Available Power Gain | $G_{ma}$ | | <br>18.5<br>20 | | dB | $Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Input 1 dB Gain compression point | $IP_{1dB}$ | | -4.5<br>-6.5 | | dBm | $I_{Cq}$ = 6 mA<br>$I_{Cq}$ = 10 mA |
| Input 3rd Order Intercept Point[3] | $IIP_3$ | | 2.5<br>1 | | dBm | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Input Return Loss | $R.L._{in}$ | | 14.5<br>16 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Output Return Loss | $R.L._{out}$ | | 14<br>23 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |

1) Test fixture losses extracted
2) Test fixture losses extracted
3) Measured on an application board according to figure 2) presenting roughly a 50 Ω system to the device. $I_{Cq}$ is the quiescent current, that is at small RF input power level. $I_C$ increases as RF input power level approaches P1dB.

**Table 10 AC Characteristics, $V_C$ = 3 V, $f$ = 1900 MHz**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Minimum Noise Figure[1] | $NF_{min}$ | | <br>1.05<br>1.05 | | dB | $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Noise Figure in 50Ω System[2] | $NF_{50}$ | | <br>1.15<br>1.1 | | dB | $Z_S = Z_L = 50\Omega$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Transducer Gain | $\lvert S_{21}\rvert^2$ | | 17.5<br>19 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Maximum Available Power Gain | $G_{ma}$ | | <br>18<br>19.5 | | dB | $Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Input 1 dB Gain compression point | $IP_{1dB}$ | | -4<br>-6 | | dBm | $I_{Cq}$ = 6 mA<br>$I_{Cq}$ = 10 mA |
| Input 3rd Order Intercept Point[3] | $IIP_3$ | | 2.5<br>1 | | dBm | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Input Return Loss | $R.L._{in}$ | | 13.5<br>15 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Output Return Loss | $R.L._{out}$ | | 13.5<br>21 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |

1) Test fixture losses extracted
2) Test fixture losses extracted
3) Measured on an application board according to figure 2) presenting roughly a 50 Ω system to the device. $I_{Cq}$ is the quiescent current, that is at small RF input power level. $I_C$ increases as RF input power level approaches P1dB.

**Table 11 AC Characteristics, $V_C$ = 3 V, $f$ = 2400 MHz**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Minimum Noise Figure[1] | $NF_{min}$ | | <br>1.1<br>1.05 | | dB | $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Noise Figure in 50Ω System[2] | $NF_{50}$ | | <br>1.15<br>1.1 | | dB | $Z_S = Z_L = 50\Omega$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Transducer Gain | $\lvert S_{21}\rvert^2$ | | 17<br>18.5 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Maximum Available Power Gain | $G_{ma}$ | | <br>17.5<br>19 | | dB | $Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Input 1 dB Gain compression point[3] | $IP_{1dB}$ | | -3.5<br>-5.5 | | dBm | $I_{Cq}$ = 6 mA<br>$I_{Cq}$ = 10 mA |
| Input 3rd Order Intercept Point | $IIP_3$ | | 3<br>1 | | dBm | $I_C$ = 6 mA<br>$I_C$ = 10 mA |

**Table 11 AC Characteristics, $V_C$ = 3 V, (cont'd) $f$ = 2400 MHz**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Input Return Loss | $R.L._{in}$ | | 12.5<br>13.5 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Output Return Loss | $R.L._{out}$ | | 12.5<br>18 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |

1) Test fixture losses extracted
2) Test fixture losses extracted
3) Measured on an application board according to figure 2) presenting roughly a 50 Ω system to the device. $I_{Cq}$ is the quiescent current, that is at small RF input power level. $I_C$ increases as RF input power level approaches P1dB.

**Table 12 AC Characteristics, $V_C$ = 3 V, $f$ = 3500 MHz**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Minimum Noise Figure[1] | $NF_{min}$ | | <br>1.25<br>1.2 | | dB | $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Noise Figure in 50Ω System[2] | $NF_{50}$ | | <br>1.35<br>1.25 | | dB | $Z_S = Z_L$ = 50Ω<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Transducer Gain | $\|S_{21}\|^2$ | | 15<br>16.5 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Maximum Available Power Gain | $G_{ma}$ | | <br>16<br>17.5 | | dB | $Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Input 1 dB Gain compression point[3] | $IP_{1dB}$ | | -2.5<br>-4.5 | | dBm | $I_{Cq}$ = 6 mA<br>$I_{Cq}$ = 10 mA |
| Input 3rd Order Intercept Point | $IIP_3$ | | 3.5<br>1.5 | | dBm | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Input Return Loss | $R.L._{in}$ | | 10<br>10.5 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Output Return Loss | $R.L._{out}$ | | 10<br>13.5 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |

1) Test fixture losses extracted
2) Test fixture losses extracted
3) Measured on an application board according to figure 2) presenting roughly a 50 Ω system to the device. $I_{Cq}$ is the quiescent current, that is at small RF input power level. $I_C$ increases as RF input power level approaches P1dB.

**Table 13 AC Characteristics, $V_C$ = 3 V, $f$ = 5500 MHz**

| Parameter | Symbol | Values | | | Unit | Note / Test Condition |
|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | | |
| Minimum Noise Figure[1] | $NF_{min}$ | | <br>1.8<br>1.75 | | dB | $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Noise Figure in 50Ω System[2] | $NF_{50}$ | | <br>1.95<br>1.85 | | dB | $Z_S = Z_L = 50\Omega$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Transducer Gain | $\|S_{21}\|^2$ | | 12<br>13 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Maximum Available Power Gain | $G_{ma}$ | | <br>14<br>15 | | dB | $Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$<br>$I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Input 1 dB Gain compression point[3] | $IP_{1dB}$ | | -1<br>-3 | | dBm | $I_{Cq}$ = 6 mA<br>$I_{Cq}$ = 10 mA |
| Input 3rd Order Intercept Point | $IIP_3$ | | 8.5<br>4 | | dBm | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Input Return Loss | $R.L._{in}$ | | 7<br>8 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |
| Output Return Loss | $R.L._{out}$ | | 7<br>8.5 | | dB | $I_C$ = 6 mA<br>$I_C$ = 10 mA |

1) Test fixture losses extracted

2) Test fixture losses extracted

3) Measured on an application board according to figure 2) presenting roughly a 50 Ω system to the device. $I_{Cq}$ is the quiescent current, that is at small RF input power level. $I_C$ increases as RF input power level approaches P1dB.

# 7 Package Information

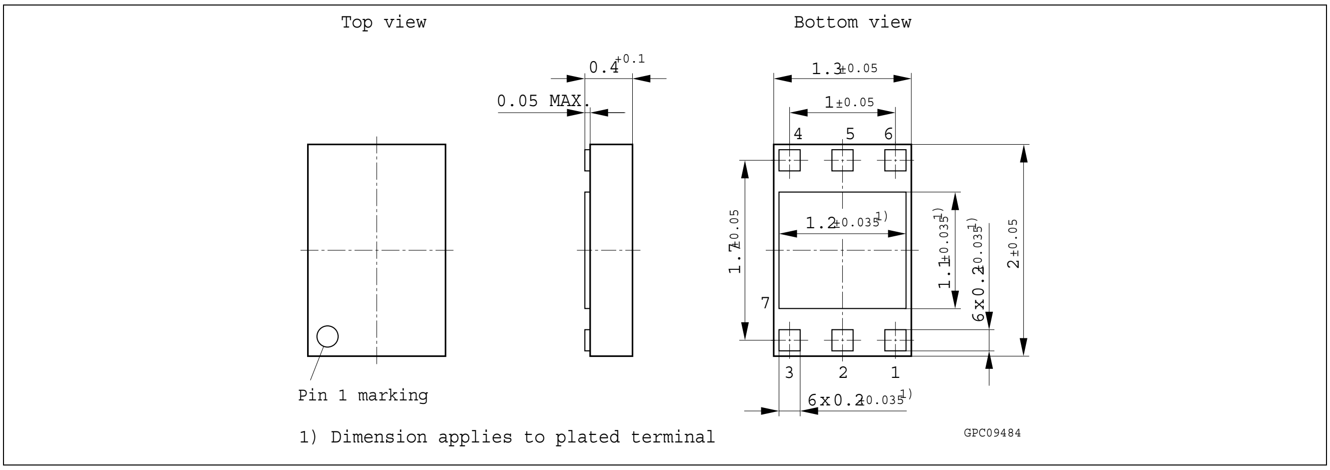



**Figure 5 Package Outline of TSLP-7-1**

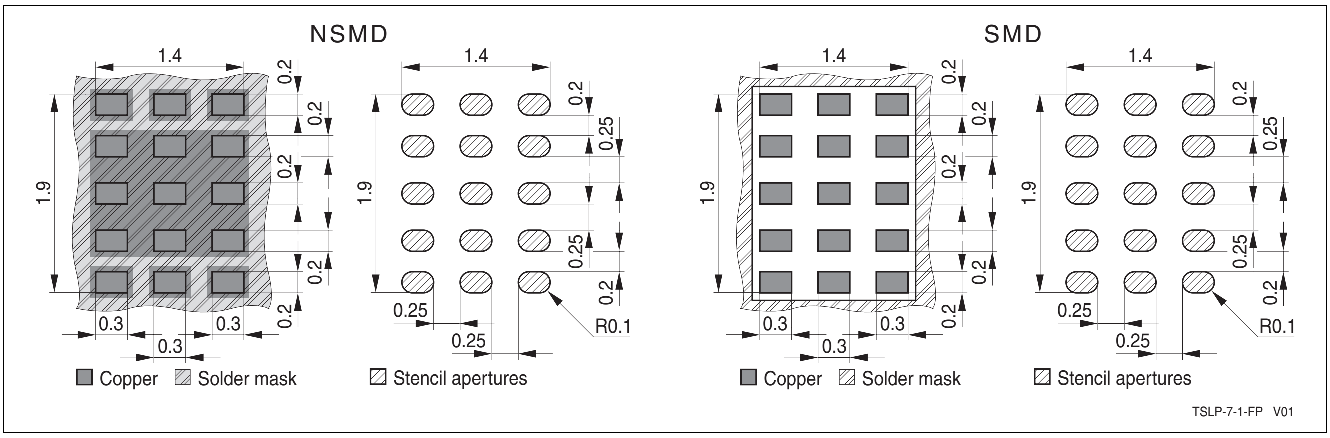



**Figure 6 Foot Print of TSLP-7-1**

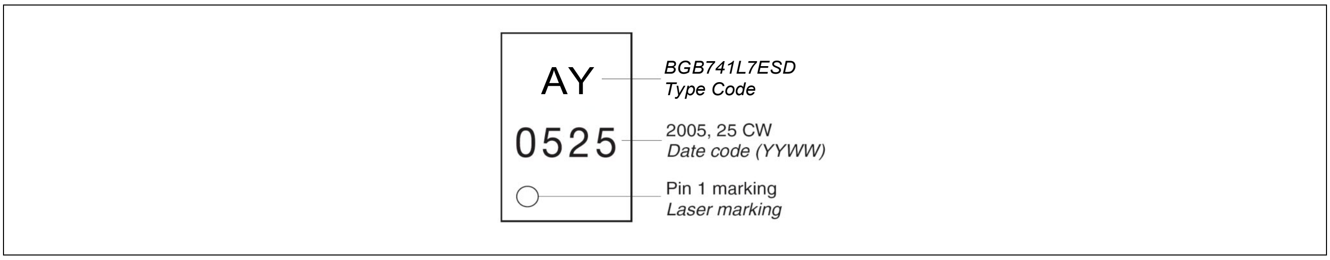



**Figure 7 Marking Layout of TSLP-7-1**

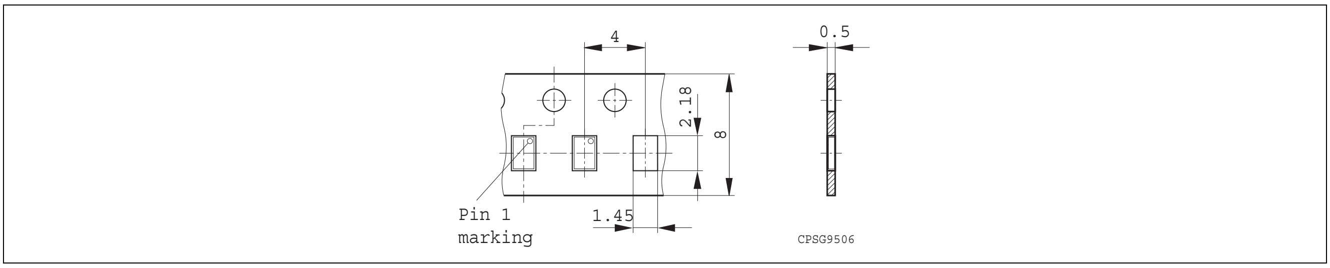



**Figure 8 Tape of TSLP-7-1**