BGB741L7ESD

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

RF & Protection Devices

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BGB741L7ESD, ESD-Robust and Easy-To-Use Broadband LNA MMIC

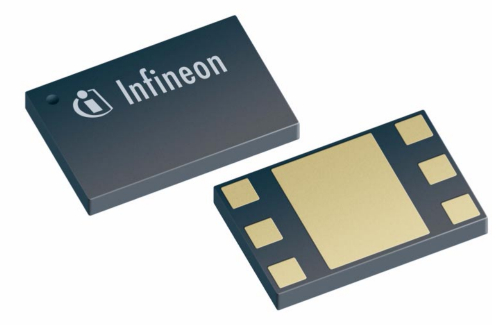
Revision History: 2009-04-17, Rev. 1.0

Prevision History: no previous version

Page	Subjects (major changes since last revision)

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



RoHS

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

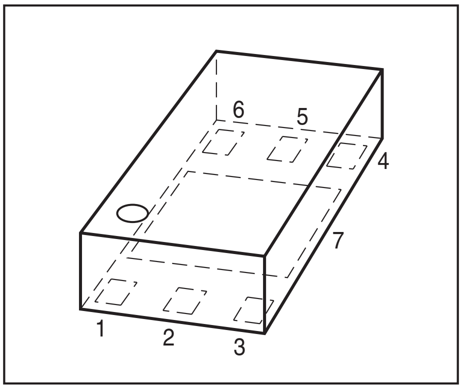


Figure 1 Pin configuration

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.

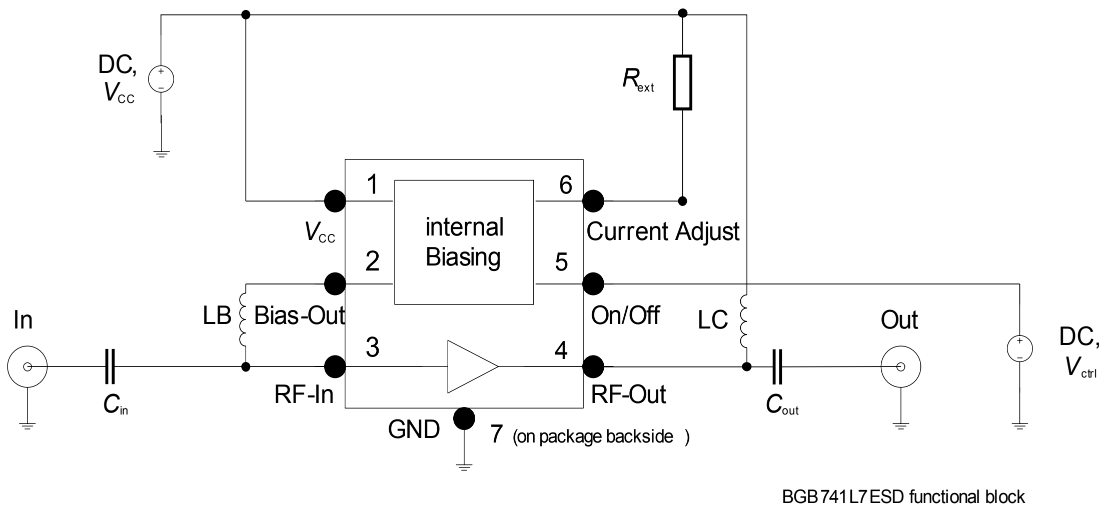


Figure 2 Functional block diagram

3 Maximum Ratings

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

Parameter	Symbol	Value	Unit
Supply voltage T_A = -55°C	V_{CC}	4.0 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)] 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

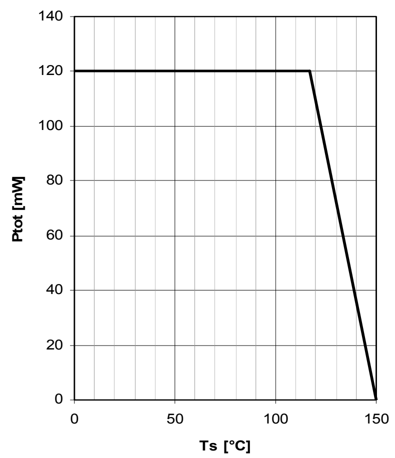


Figure 3 Maximum total Power Dissipation P_{tot} as function of temperature T_S at soldering point

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 10	7.2	mA	R_{ext} = open R_{ext} = 4 kΩ V_{CC} = 3.0 V V_{ctrl} = 3.0 V (Small signal operation)
Supply current in Off mode	$I_{CC\text{-}off}$			6.0	µA	V_{CC} = 3.0 V 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 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 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.

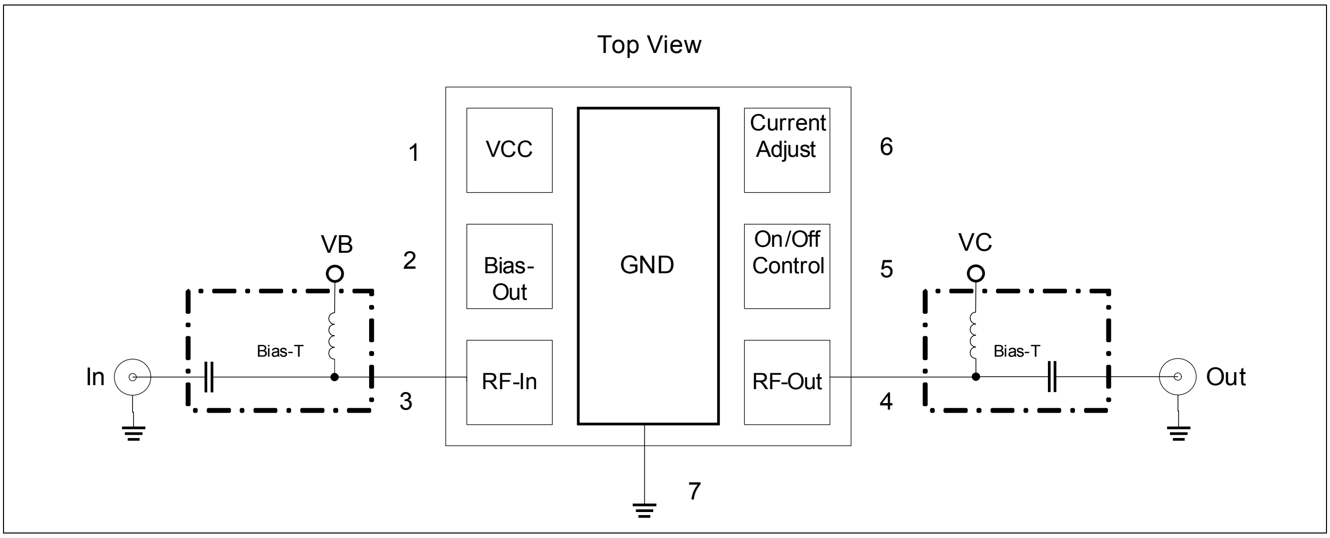


Figure 4 BGB741L7ESD testing setup

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}		 1.05 0.95		dB	$Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Noise Figure in 50Ω System[2]	NF_{50}		 1.1 1.05		dB	$Z_S = Z_L$ = 50Ω I_C = 6 mA I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$		19 21		dB	I_C = 6 mA I_C = 10 mA
Maximum Stable Power Gain	G_{ms}		 20 21.5		dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Input 1 dB Gain compression point[3]	IP_{1dB}		-5.5 -8		dBm	I_{Cq} = 6 mA I_{Cq} = 10 mA
Input 3rd Order Intercept Point	IIP_3		5.5 3.5		dBm	I_C = 6 mA I_C = 10 mA
Input Return Loss	$R.L._{in}$		14 18		dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	$R.L._{out}$		12.5 18.5		dB	I_C = 6 mA 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}		 1.05 0.95		dB	$Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Noise Figure in 50Ω System[2]	NF_{50}		 1.1 1.05		dB	$Z_S = Z_L = 50\Omega$ I_C = 6 mA I_C = 10 mA
Transducer Gain	$\lvert S_{21}\rvert^2$		18.5 20.5		dB	I_C = 6 mA I_C = 10 mA
Maximum Available Power Gain	G_{ma}		 19 20.5		dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Input 1 dB Gain compression point[3]	IP_{1dB}		-5 -7.5		dBm	I_{Cq} = 6 mA I_{Cq} = 10 mA
Input 3rd Order Intercept Point	IIP_3		4 2.5		dBm	I_C = 6 mA I_C = 10 mA
Input Return Loss	$R.L._{in}$		15.5 21		dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	$R.L._{out}$		14.5 28		dB	I_C = 6 mA 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}		 1.05 0.95		dB	$Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Noise Figure in 50Ω System[2]	NF_{50}		 1.1 1.05		dB	$Z_S = Z_L = 50\Omega$ I_C = 6 mA I_C = 10 mA
Transducer Gain	$\lvert S_{21}\rvert^2$		18.5 20		dB	I_C = 6 mA I_C = 10 mA
Maximum Available Power Gain	G_{ma}		 19 20.5		dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Input 1 dB Gain compression point[3]	IP_{1dB}		-5 -7		dBm	I_{Cq} = 6 mA I_{Cq} = 10 mA
Input 3rd Order Intercept Point	IIP_3		3 1.5		dBm	I_C = 6 mA 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 19		dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	$R.L._{out}$		14.5 28.5		dB	I_C = 6 mA 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}		 1.05 1.0		dB	$Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Noise Figure in 50Ω System[2]	NF_{50}		 1.1 1.05		dB	$Z_S = Z_L$ = 50Ω I_C = 6 mA I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$		18 19.5		dB	I_C = 6 mA I_C = 10 mA
Maximum Available Power Gain	G_{ma}		 18.5 20		dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Input 1 dB Gain compression point	IP_{1dB}		-4.5 -6.5		dBm	I_{Cq} = 6 mA I_{Cq} = 10 mA
Input 3rd Order Intercept Point[3]	IIP_3		2.5 1		dBm	I_C = 6 mA I_C = 10 mA
Input Return Loss	$R.L._{in}$		14.5 16		dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	$R.L._{out}$		14 23		dB	I_C = 6 mA 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}		 1.05 1.05		dB	$Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Noise Figure in 50Ω System[2]	NF_{50}		 1.15 1.1		dB	$Z_S = Z_L = 50\Omega$ I_C = 6 mA I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$		17.5 19		dB	I_C = 6 mA I_C = 10 mA
Maximum Available Power Gain	G_{ma}		 18 19.5		dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Input 1 dB Gain compression point	IP_{1dB}		-4 -6		dBm	I_{Cq} = 6 mA I_{Cq} = 10 mA
Input 3rd Order Intercept Point[3]	IIP_3		2.5 1		dBm	I_C = 6 mA I_C = 10 mA
Input Return Loss	$R.L._{in}$		13.5 15		dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	$R.L._{out}$		13.5 21		dB	I_C = 6 mA 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}		 1.1 1.05		dB	$Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Noise Figure in 50Ω System[2]	NF_{50}		 1.15 1.1		dB	$Z_S = Z_L = 50\Omega$ I_C = 6 mA I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$		17 18.5		dB	I_C = 6 mA I_C = 10 mA
Maximum Available Power Gain	G_{ma}		 17.5 19		dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Input 1 dB Gain compression point[3]	IP_{1dB}		-3.5 -5.5		dBm	I_{Cq} = 6 mA I_{Cq} = 10 mA
Input 3rd Order Intercept Point	IIP_3		3 1		dBm	I_C = 6 mA 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 13.5		dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	$R.L._{out}$		12.5 18		dB	I_C = 6 mA 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}		 1.25 1.2		dB	$Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Noise Figure in 50Ω System[2]	NF_{50}		 1.35 1.25		dB	$Z_S = Z_L$ = 50Ω I_C = 6 mA I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$		15 16.5		dB	I_C = 6 mA I_C = 10 mA
Maximum Available Power Gain	G_{ma}		 16 17.5		dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Input 1 dB Gain compression point[3]	IP_{1dB}		-2.5 -4.5		dBm	I_{Cq} = 6 mA I_{Cq} = 10 mA
Input 3rd Order Intercept Point	IIP_3		3.5 1.5		dBm	I_C = 6 mA I_C = 10 mA
Input Return Loss	$R.L._{in}$		10 10.5		dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	$R.L._{out}$		10 13.5		dB	I_C = 6 mA 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}		 1.8 1.75		dB	$Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Noise Figure in 50Ω System[2]	NF_{50}		 1.95 1.85		dB	$Z_S = Z_L = 50\Omega$ I_C = 6 mA I_C = 10 mA
Transducer Gain	$\lvert S_{21}\rvert^2$		12 13		dB	I_C = 6 mA I_C = 10 mA
Maximum Available Power Gain	G_{ma}		 14 15		dB	$Z_L = Z_{Lopt}$, $Z_S = Z_{Sopt}$ I_C = 6 mA I_C = 10 mA
Input 1 dB Gain compression point[3]	IP_{1dB}		-1 -3		dBm	I_{Cq} = 6 mA I_{Cq} = 10 mA
Input 3rd Order Intercept Point	IIP_3		8.5 4		dBm	I_C = 6 mA I_C = 10 mA
Input Return Loss	$R.L._{in}$		7 8		dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	$R.L._{out}$		7 8.5		dB	I_C = 6 mA 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

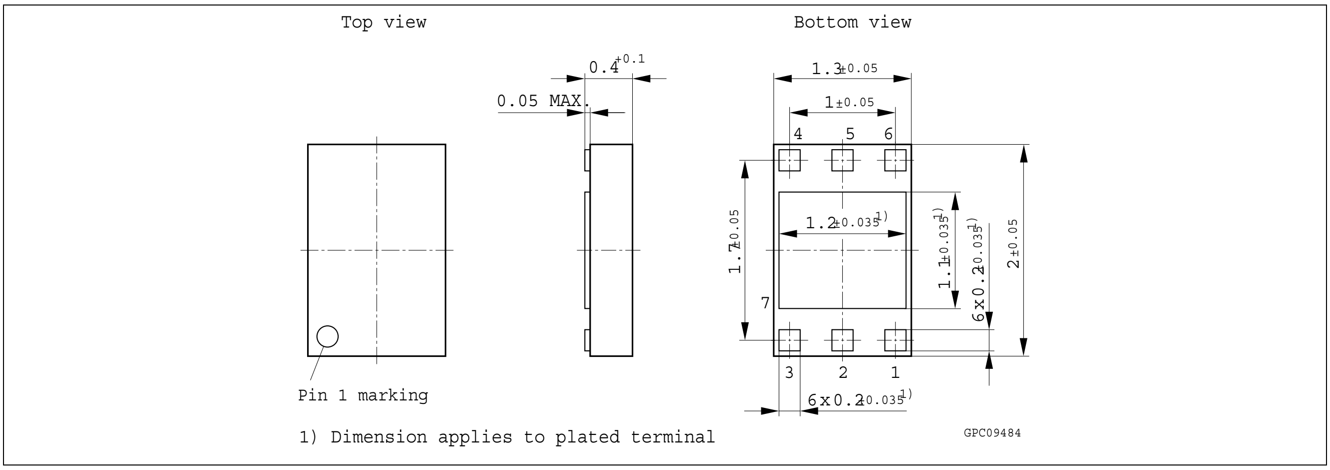


Figure 5 Package Outline of TSLP-7-1

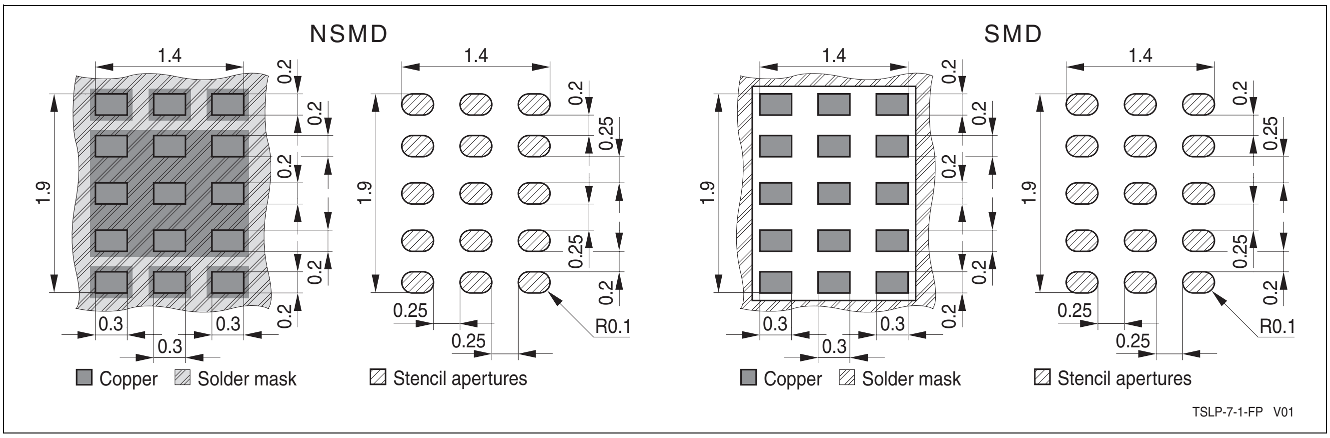


Figure 6 Foot Print of TSLP-7-1

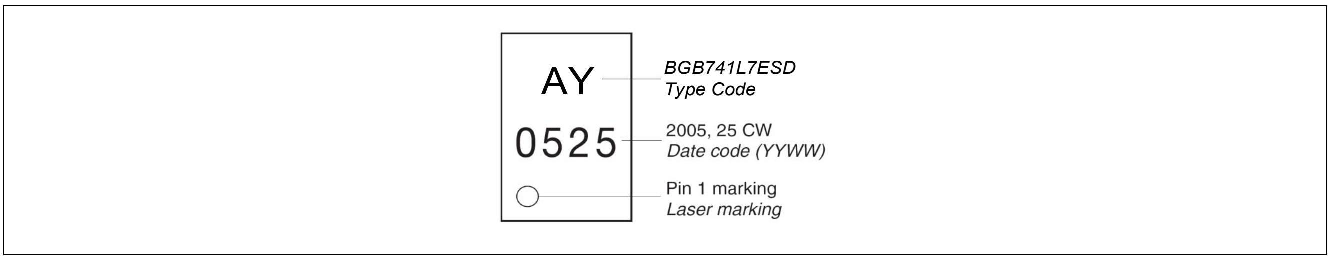


Figure 7 Marking Layout of TSLP-7-1

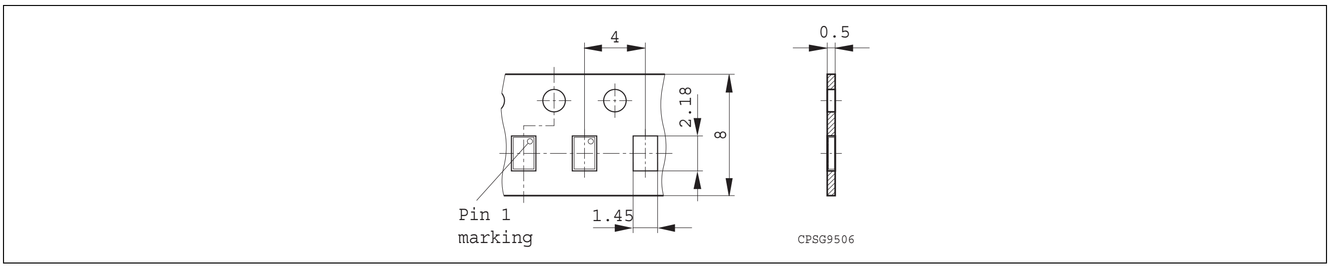


Figure 8 Tape of TSLP-7-1