BGB741L7ESD

Robust Low Noise Broadband RF Amplifier MMIC

Data Sheet

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

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Page	Subjects (major changes since last revision)
	This datasheet replaces the version from 2009-04-17. Neither the wafer production nor the package assembly have been changed. Only the product description and information available in the datasheet has been expanded and adjusted to the typical production.

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1 Product Brief

The BGB741L7ESD is a high performance low noise amplifier (LNA) MMIC based on Infineon's reliable high volume silicon germanium carbon (SiGe:C) bipolar technology. Its integrated feedback provides a broadband pre-match to 50 Ω at input and output up to 3.5 GHz and improves the stability against parasitic oscillations. These measures simplify the design of arbitrary LNA application circuits. The integrated active biasing reduces the external parts count and stabilizes the bias current against temperature- and process-variations. The integrated protection elements make the device robust against electrostatic discharge (ESD) and high RF input power levels. The device is highly flexible because the bias current is adjustable and the device works with a broad supply voltage range. The BGB741L7ESD comes in a Pb-free and halogen-free low profile TSLP-7-1 package.

2 Features

- High-performance broadband LNA MMIC for applications between 50 MHz and 5 GHz
- Integrated ESD protection: 2 kV HBM at all pins
- High RF input power robustness of 20 dBm
- Supply voltage range V_{CC} = 1.8 - 4.0 V
- Adjustable current between 5.5 mA to 30 mA by an external resistor
- Power-off function
- Excellent noise figure for a broadband LNA: NF_{50} = 1.15 dB at 6 mA, 3 V, 2.4 GHz
- Very small, leadless, Pb-free (RoHS compliant) and halogen-free package TSLP-7-1, 2.0 x 1.3 x 0.4 mm
- Qualification report according to AEC-Q101 available

TSLP-7-1

RoHS

HAL

Applications

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

3 Pin Configuration

Type	Package	Marking
BGB741L7ESD	TSLP-7-1	AY

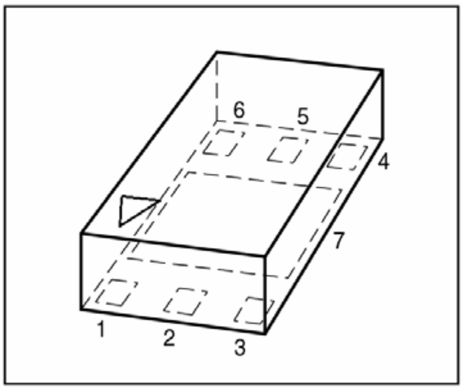

Figure 3-1 Pin Configuration

Table 3-1 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

4 Application Circuit

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 minimum current of 5.5mA (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.

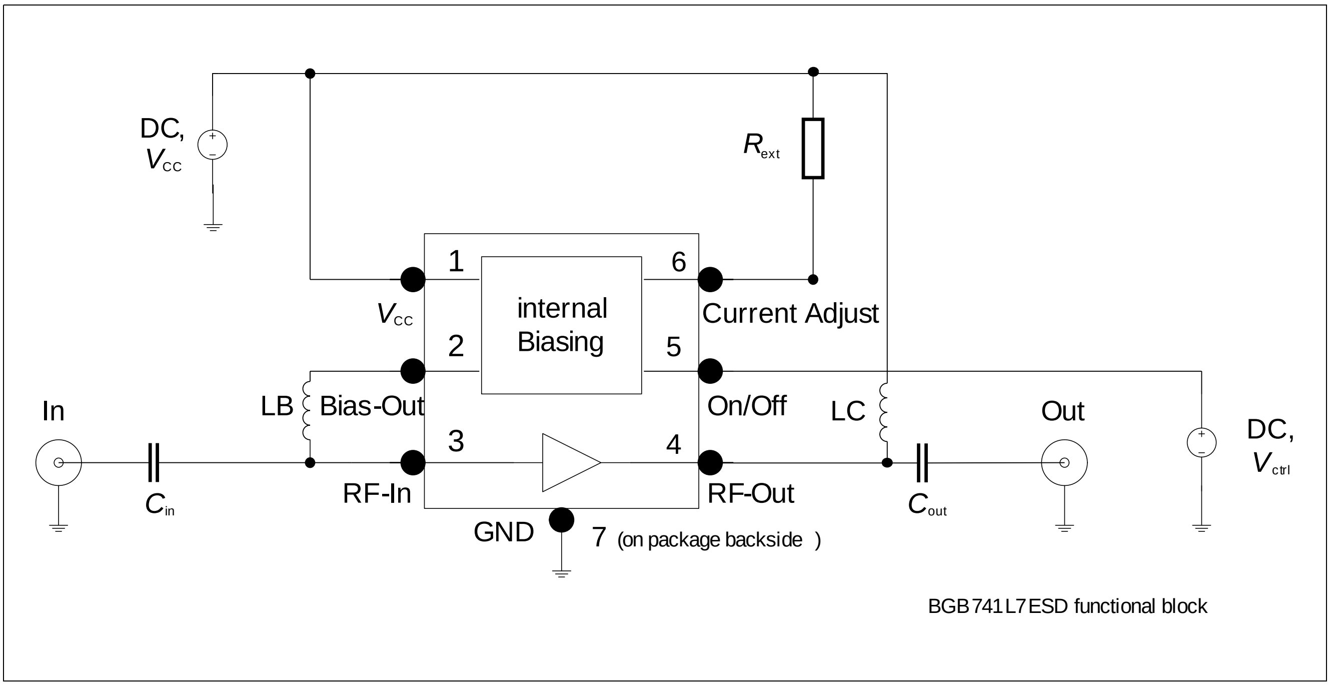

Figure 4-1 Functional Block Diagram

5 Operating Conditions

Table 5-1 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	$V_{Ctrl-on}$	1.2	–	V_{CC}		
Voltage Control On/Off pin in Off mode	$V_{Ctrl-off}$	-0.3	–	0.3	V	

6 Maximum Ratings

Table 6-1 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}	V_{CC}	
ESD stress pulse (HBM)	V_{ESD}	+/-2	kV
RF input power	$P_{RF,in}$	20	dBm
Total power dissipation[1)] T_S<117°C	P_{tot}	120	mW
Junction temperature	T_J	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 operating conditions

Attention: ESD (Electrostatic Discharge) sensitive device, observe handling precautions.

7 Thermal Characteristics

Table 7-1 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 AN077 (Thermal Resistance Calculation)

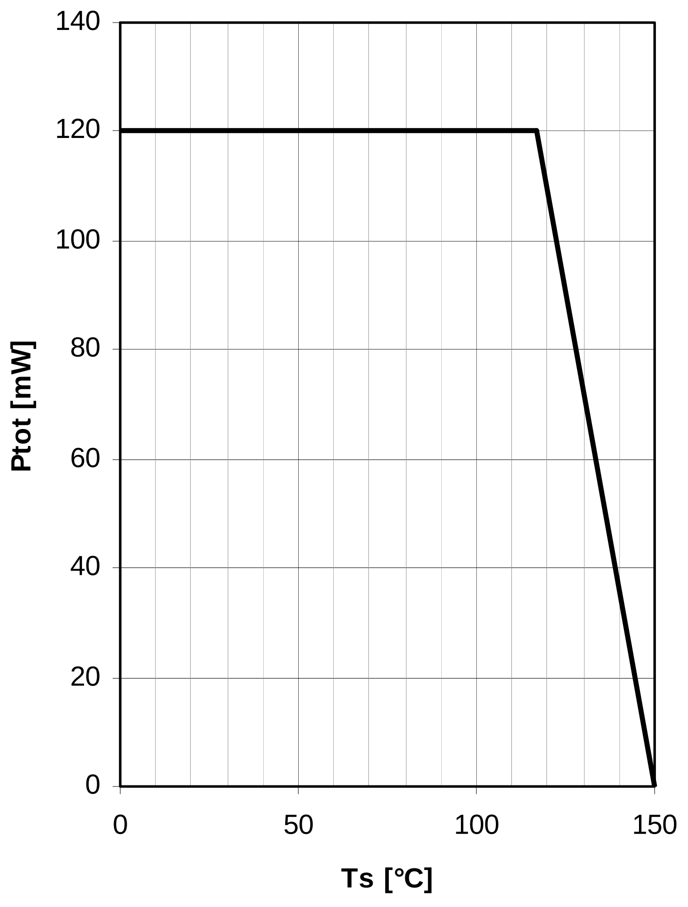

Figure 7-1 Maximum Total Power Dissipation P_{tot} as Function of Temperature T_S at Soldering point

8 Electrical Characteristics

8.1 DC Characteristics

Table 8-1 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 – –	5.5 6 10	6.5 – –	mA	R_{ext} = open R_{ext} = 30 kΩ R_{ext} = 3 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

8.2 DC Characteristics Under Varying Bias Conditions

The measurement setup is an application circuit according to **Figure 4-1 "Functional Block Diagram" on Page 9** using the integrated biasing.

T_A = 25 °C unless otherwise specified.

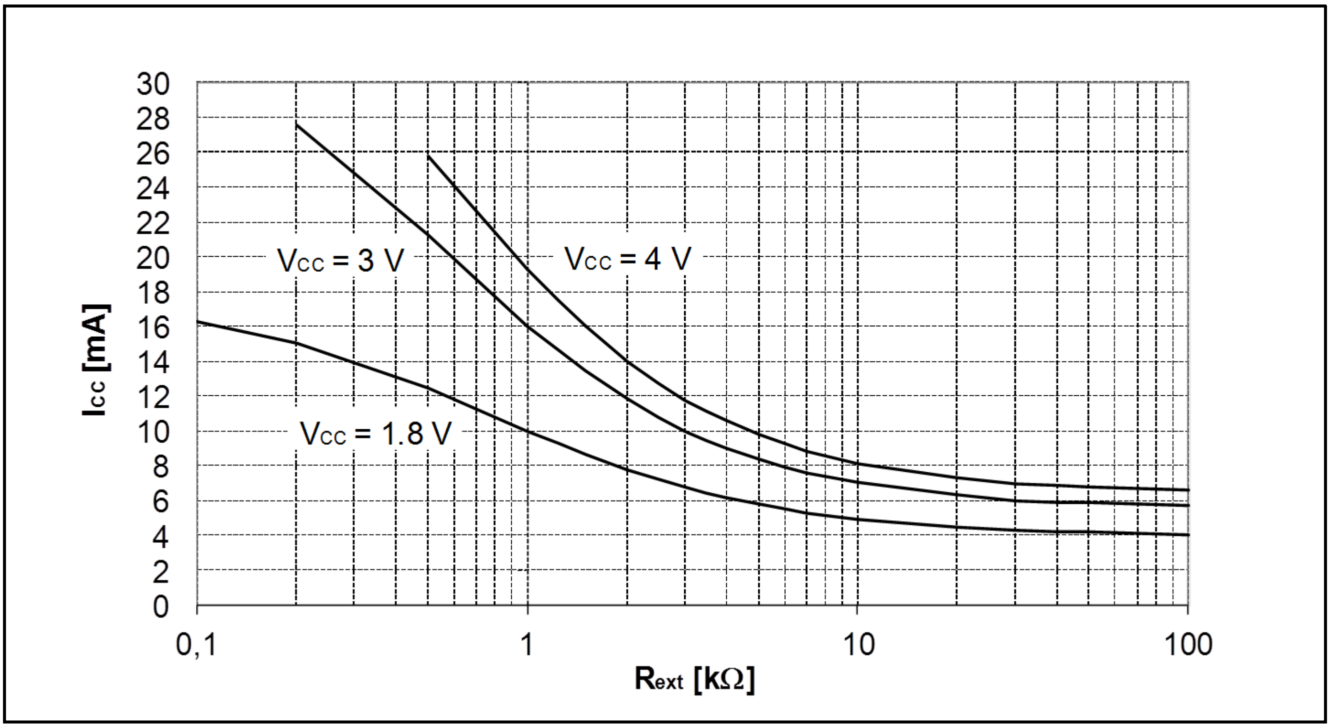

Figure 8-1 I_{CC} **as a Function of** R_{ext}, V_{Ctrl} **= 3 V,** V_{CC} **as Parameter**

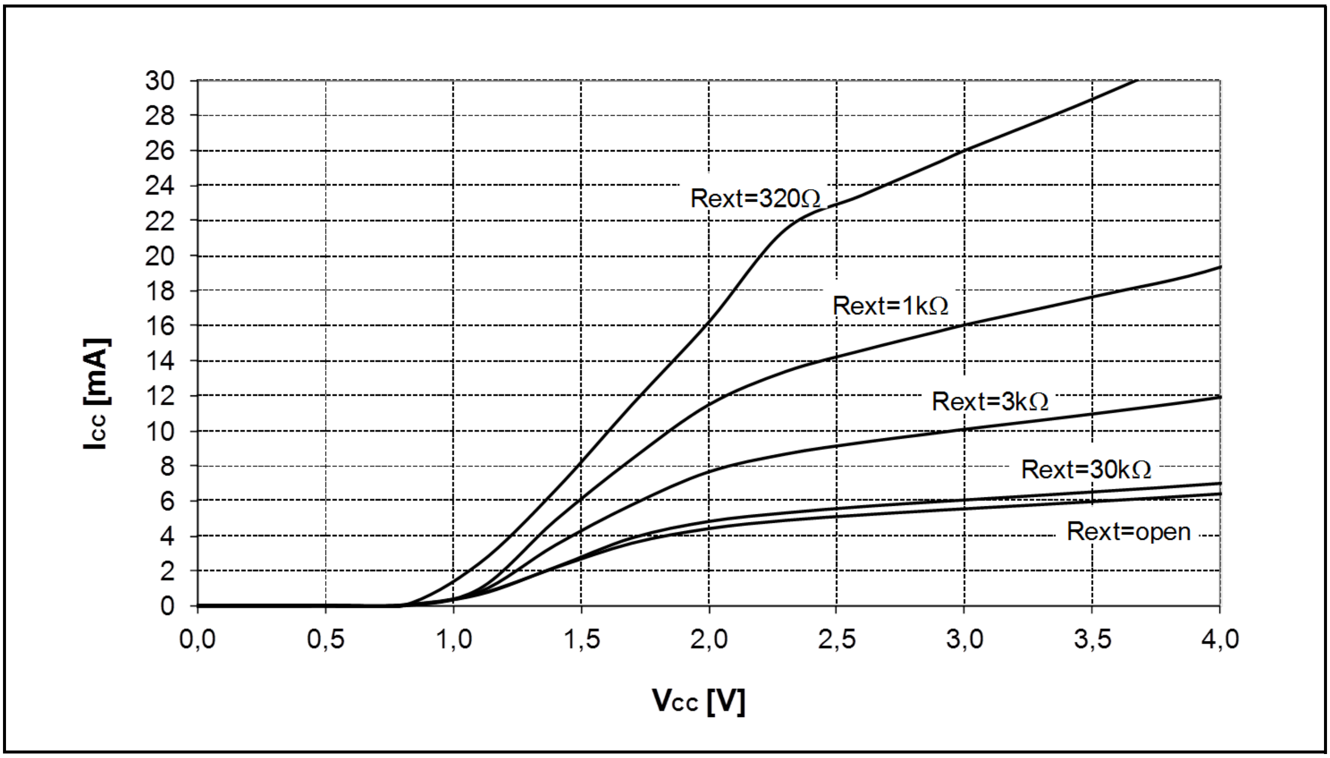

Figure 8-2 I_{CC} **as a Function of** V_{CC}, V_{Ctrl} **= 3 V,** R_{ext} **as Parameter**

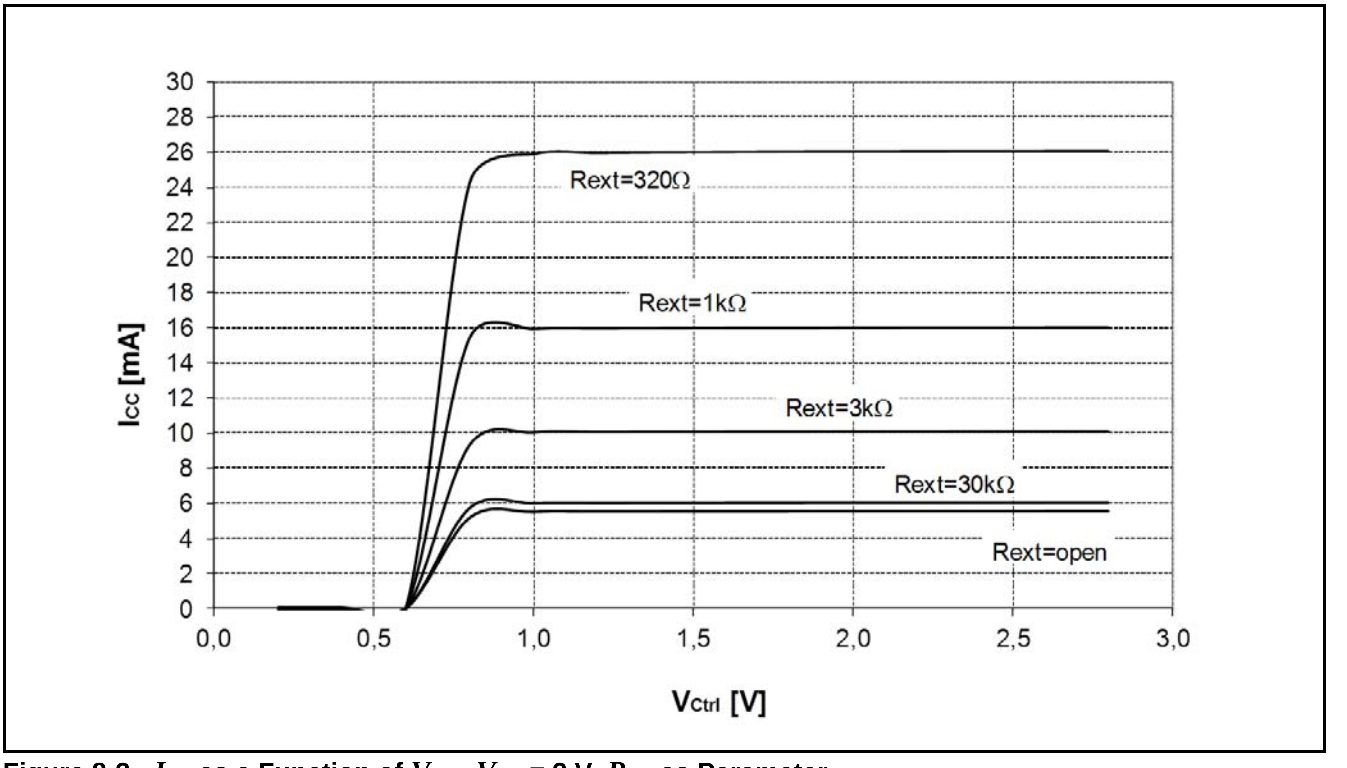

Figure 8-3 I_{CC} **as a Function of** V_{Ctrl}, V_{CC} **= 3 V,** R_{ext} **as Parameter**

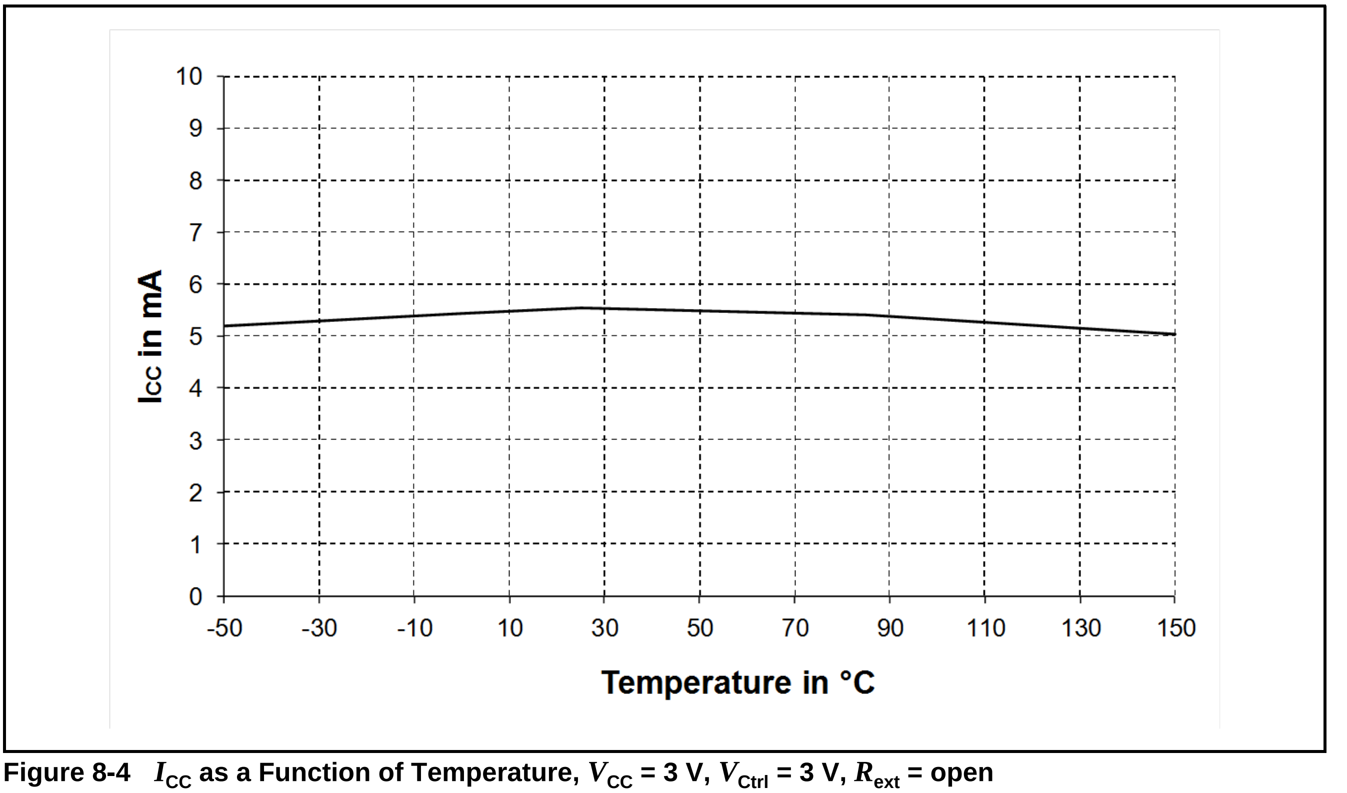

Figure 8-4 I_{CC} **as a Function of Temperature,** V_{CC} **= 3 V,** V_{Ctrl} **= 3 V,** R_{ext} **= open**

8.3 AC Characteristics

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

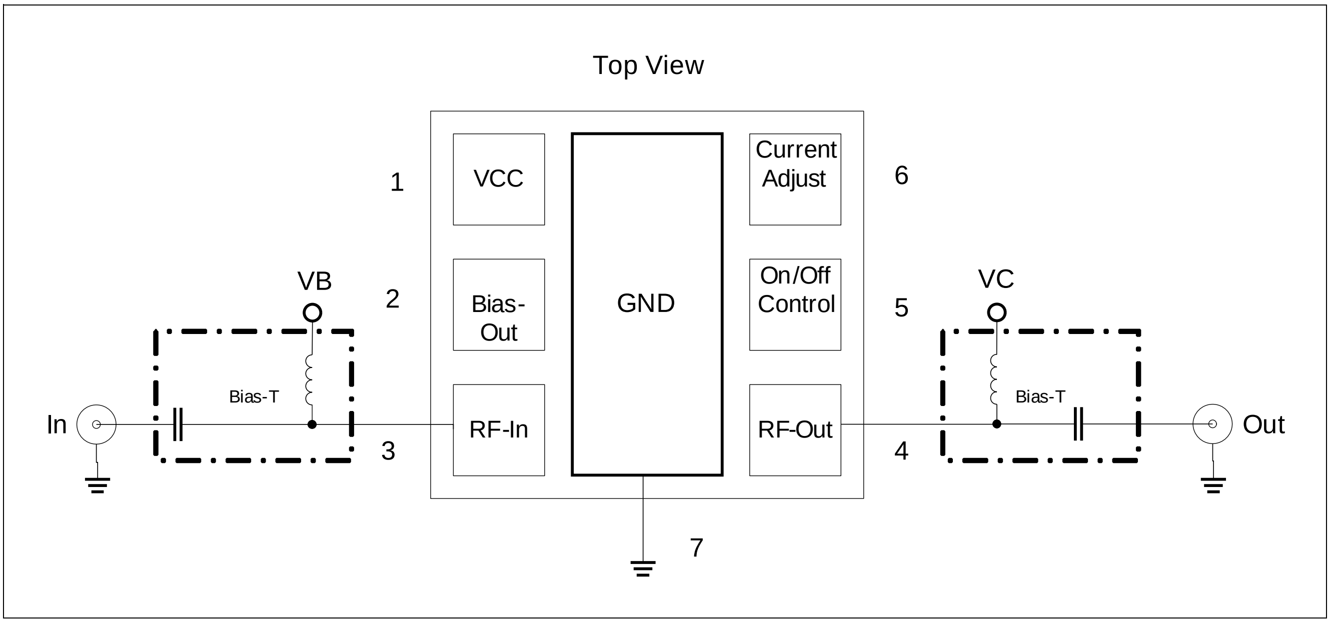

Figure 8-5 Testing Setup

Table 8-2 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[1)]	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[2)]	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	RL_{in}	– –	14 18	– –	dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	RL_{out}	– –	12.5 18.5	– –	dB	I_C = 6 mA I_C = 10 mA

Table 8-3 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[1)]	NF_{50}	 – –	 1.1 1.05	 – –	dB	$Z_S = Z_L = 50\Omega$ I_C = 6 mA I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$	– –	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[2)]	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	RL_{in}	– –	15.5 21	– –	dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	RL_{out}	– –	14.5 28	– –	dB	I_C = 6 mA I_C = 10 mA

Table 8-4 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[1)]	NF_{50}	 – –	 1.1 1.05	 – –	dB	$Z_S = Z_L = 50\Omega$ I_C = 6 mA I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$	– –	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[2)]	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 8-4 AC Characteristics, V_C = 3 V, *f* = 900 MHz (cont'd)

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input Return Loss	RL_{in}	– –	15.5 19	– –	dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	RL_{out}	– –	14.5 28.5	– –	dB	I_C = 6 mA I_C = 10 mA

Table 8-5 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[1)]	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[2)]	IP_{1dB}	– –	-4.5 -6.5	– –	dBm	I_{Cq} = 6 mA I_{Cq} = 10 mA
Input 3rd Order Intercept Point	IIP_3	– –	2.5 1	– –	dBm	I_C = 6 mA I_C = 10 mA
Input Return Loss	RL_{in}	– –	14.5 16	– –	dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	RL_{out}	– –	14 23	– –	dB	I_C = 6 mA I_C = 10 mA

Table 8-6 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[1)]	NF_{50}	 – –	 1.15 1.1	 – –	dB	$Z_S = Z_L$ = 50Ω 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

Table 8-6 AC Characteristics, V_C = 3 V, f = 1900 MHz (cont'd)

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
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[2)]	IP_{1dB}	– –	-4 -6	– –	dBm	I_{Cq} = 6 mA I_{Cq} = 10 mA
Input 3rd Order Intercept Point	IIP_3	– –	2.5 1	– –	dBm	I_C = 6 mA I_C = 10 mA
Input Return Loss	RL_{in}	– –	13.5 15	– –	dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	RL_{out}	– –	13.5 21	– –	dB	I_C = 6 mA I_C = 10 mA

Table 8-7 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[1)]	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[2)]	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
Input Return Loss	RL_{in}	– –	12.5 13.5	– –	dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	RL_{out}	– –	12.5 18	– –	dB	I_C = 6 mA I_C = 10 mA

Table 8-8 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[1]	NF_{50}	 – –	 1.35 1.25	 – –	dB	$Z_S = Z_L = 50\Omega$ 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[2]	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	RL_{in}	– –	10 10.5	– –	dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	RL_{out}	– –	10 13.5	– –	dB	I_C = 6 mA I_C = 10 mA

Table 8-9 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[1]	NF_{50}	 – –	 1.95 1.85	 – –	dB	$Z_S = Z_L = 50\Omega$ I_C = 6 mA I_C = 10 mA
Transducer Gain	$\|S_{21}\|^2$	– –	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[2]	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

Table 8-9 AC Characteristics, V_C = 3 V, f = 5500 MHz (cont'd)

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Input Return Loss	RL_{in}	– –	7 8	– –	dB	I_C = 6 mA I_C = 10 mA
Output Return Loss	RL_{out}	– –	7 8.5	– –	dB	I_C = 6 mA I_C = 10 mA

1) Test fixture losses extracted

2) Measured on an application board according to **Figure 4-1 "Functional Block Diagram" on Page 9** presenting a 50 Ω system to the device. ICq is the quiescent current, that is at small RF input power level. I_C increases as RF input power level approaches P1dB.

9 Package Information

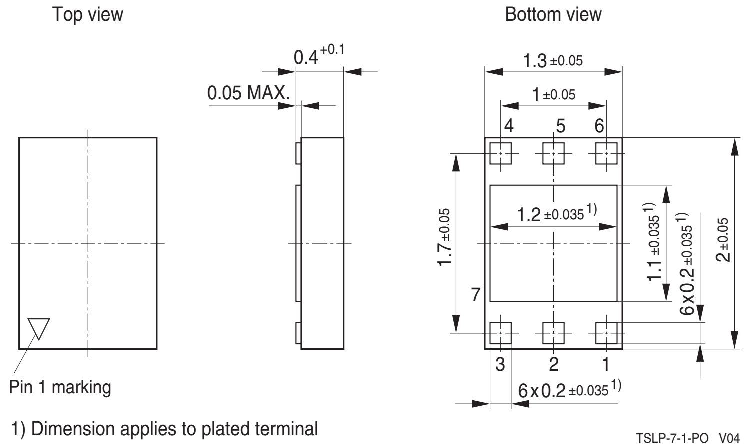

Figure 9-1 Package Outline of TSLP-7-1

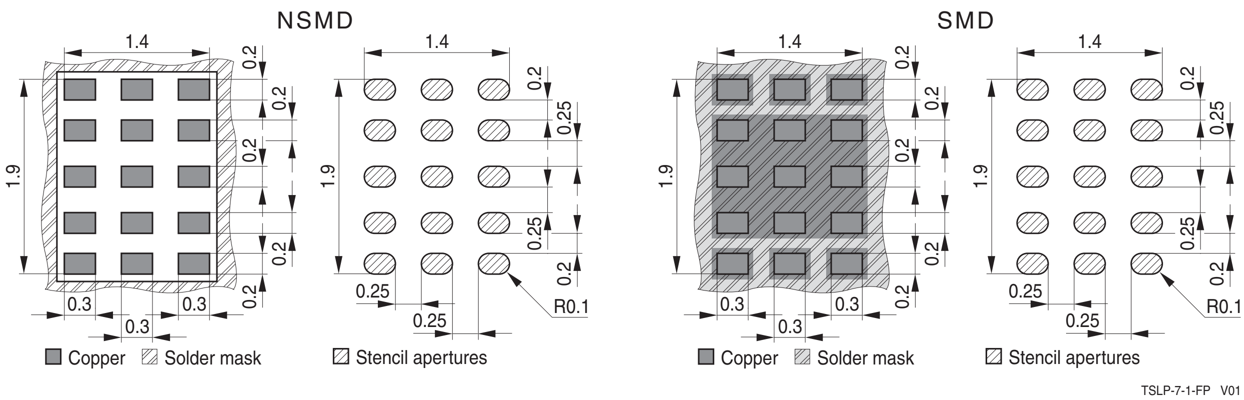

Figure 9-2 Foot Print of TSLP-7-1

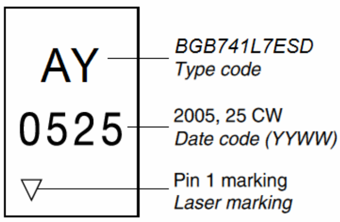

Figure 9-3 Marking Layout of TSLP-7-1

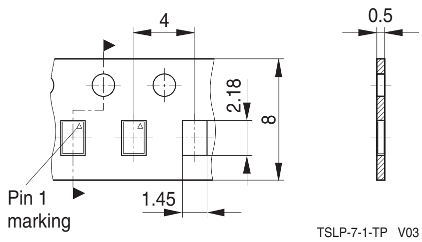

Figure 9-4 Tape of TSLP-7-1

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