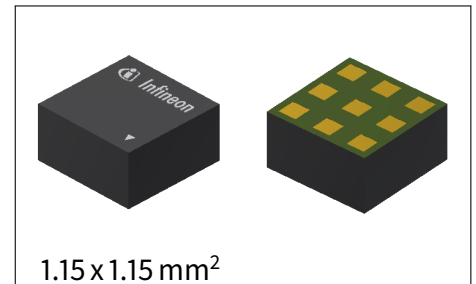


BGM13HBA9

SP3T Low Noise Amplifier Multiplexer Module with Bypass

Features

- Wideband operating frequencies: 1805 - 2690 MHz
- Insertion power gain: 15.0 dB
- Insertion loss in bypass mode: 5.3 dB
- Ultra low noise figure: 0.85 dB
- Low current consumption: 5.1 mA
- Multi-state control: OFF-, Bypass- and Gain-Mode
- Small ATSLP leadless package



Product Validation

Qualified for industrial applications according to the relevant tests of JEDEC47/20/22.

Application

The LTE data rate can be significantly improved by using the LNA Multiplexer Module (LMM). The integrated bypass function increases the overall system dynamic range and leads to more flexibility in the front-end. In high gain mode the LMM offers best Noise Figure to ensure high data rates even on the LTE cell edge. Closer to the basestation the bypass mode can be activated reducing current consumption. Thanks to the GPIO control interface, control lines are reduced to a minimum. Up to three 3GPP LTE bands in the mid- and high-band can be controlled and dynamically amplified with one Low Noise Amplifier. This reduces PCB area and system cost.

Block diagram

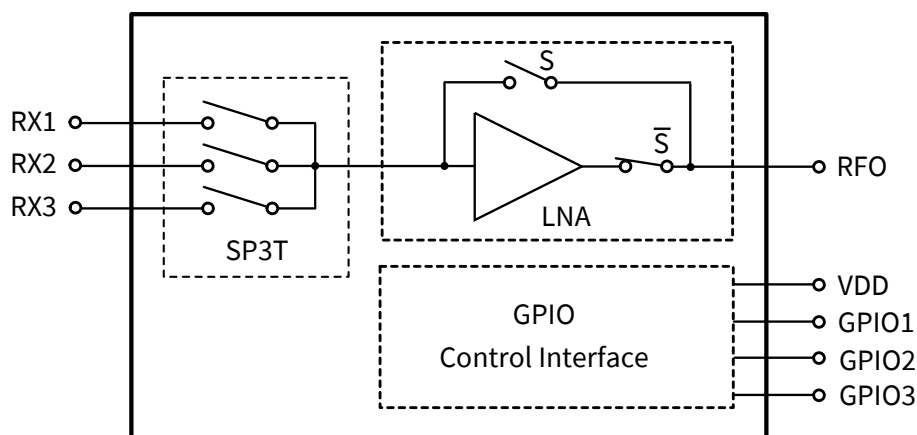


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BGM13HBA9

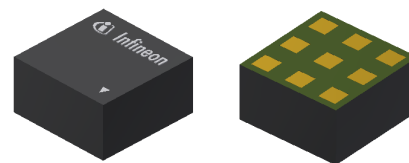
SP3T Low Noise Amplifier Multiplexer Module with Bypass



Features

1 Features

- Power gain: 15.0 dB
- Ultra low noise figure: 0.85 dB
- Low current consumption: 5.1 mA
- Wideband frequency range from 1805 to 2690 MHz
- RF output internally matched to 50 Ω
- High port-to-port-isolation
- Suitable for LTE / LTE-Advanced and 3G applications
- No decoupling capacitors required if no DC applied on RF lines
- On chip control logic including ESD protection
- Supply voltage: 1.6 to 3.1 V
- General Purpose Input-Output (GPIO) Interface
- Small form factor 1.15 mm x 1.15 mm
- High EMI robustness
- RoHS and WEEE compliant package



Description

The BGM13HBA9 is a LNA multiplexer module for LTE Mid- and High-band frequencies that increases the data rate while keeping flexibility and low footprint. It is a perfect solution for multimode handsets for 3G, 4G and Carrier Aggregation. The device configuration is shown in Fig. 1.

Product Name	Marking	Package
BGM13HBA9	3H	ATSLP-9-1

Maximum Ratings

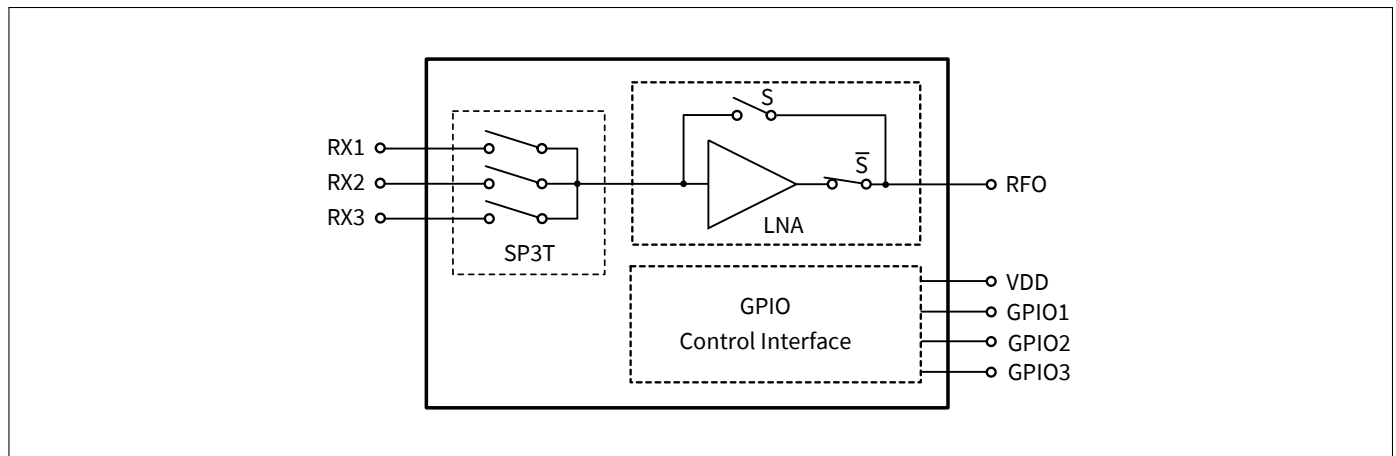


Figure 1: BGM13HBA9 Block diagram

2 Maximum Ratings

Table 1: Maximum Ratings

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Voltage VDD	V_{DD}	0.3	–	3.6	V	¹
Voltage at RF pins Rx	V_{Rx}	-0.3	–	0.9	V	–
Voltage at RF output pin RFO	V_{RFO}	-0.3	–	$V_{DD} + 0.3$	V	–
Voltage at GND pins	V_{GND}	-0.3	–	0.3	V	–
Current into pin VDD	I_{DD}	–	–	16	mA	–
RF input power	P_{IN}	–	–	0	dBm	–
Total power dissipation	P_{tot}	–	–	60	mW	–
Junction temperature	T_J	–	–	150	°C	–
Ambient temperature range	T_A	-30	–	85	°C	–
Storage temperature range	T_{STG}	-55	–	150	°C	–
ESD capability, HBM	V_{ESD_HBM}	-2000	–	2000	V	²

¹All voltages refer to GND-Nodes unless otherwise noted

²Human Body Model ANSI/ESDA/JEDEC JS-001-2014 ($R = 1.5\text{ k}\Omega$, $C = 100\text{ pF}$).

Attention: Stresses above the max. values listed here may cause permanent damage to the device. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit. Exposure to conditions at or below absolute maximum rating but above the specified maximum operation conditions may affect device reliability and life time. Functionality of the device might not be given under these conditions.

3 DC Characteristics

Table 3: DC Characteristics at $T_A = 25^\circ\text{C}$

Parameter ¹	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply Voltage	V_{DD}	1.6	2.8	3.1	V	–
Supply Current	I_{DD}	–	5.1	6.6	mA	ON Mode
		–	325	375	μA	Bypass Mode
		–	0.1	2	μA	OFF Mode

¹Based on the application described in Chapter 7

4 RF Characteristics Midband

Table 4: RF Characteristics in ON Mode at $T_A = 25^\circ\text{C}$, $V_{DD} = 2.8\text{ V}$, not used RX ports terminated with 50 Ohm

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Insertion power gain	$ S_{21} ^2$	13.5	15.0	16.5	dB	$f = 2000\text{ MHz}$
Noise figure, $Z_S = 50\ \Omega$	NF	–	0.85	1.4	dB	$f = 2000\text{ MHz}$
Input return loss	RL_{in}	8	11	–	dB	$f = 2000\text{ MHz}$
Output return loss	RL_{out}	9	12	–	dB	$f = 2000\text{ MHz}$
Reverse isolation RFO to RX port	$1/ S_{12} ^2$	22	27	–	dB	$f = 2000\text{ MHz}$
Isolation RX to RX port, adjacent	ISO	26	31	–	dB	$f = 2000\text{ MHz}$
Isolation RX to RX port, non-adjacent	ISO	29	34	–	dB	$f = 2000\text{ MHz}$
Isolation RX to RFO port	ISO	23	28	–	dB	$f = 2000\text{ MHz}$
Inband input 1dB-compression point	IP_{1dB}	-17	-13	–	dBm	$f = 2000\text{ MHz}$
Inband input 3 rd -order intercept point ¹	$IIP3$	-7	-2	–	dBm	$f_1 = 2000\text{ MHz}, f_2 = f_1 + 1\text{ MHz}$
Stability	k	> 1	–	–		$f = 20\text{ MHz} - 10\text{ GHz}$

¹Input power = -30 dBm for each tone

RF Characteristics Highband

Table 5: RF Characteristics in Bypass Mode at $T_A = 25\text{ }^{\circ}\text{C}$, $V_{DD} = 2.8\text{ V}$, not used RX ports terminated with 50 Ohm

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Insertion power gain	$ S_{21} ^2$	-6.3	-5.3	-4.3	dB	$f = 2000\text{ MHz}$
Noise figure, $Z_S = 50\text{ }\Omega$	NF	–	5.3	6.3	dB	$f = 2000\text{ MHz}$
Input return loss	RL_{in}	10	18	–	dB	$f = 2000\text{ MHz}$
Output return loss	RL_{out}	9	13	–	dB	$f = 2000\text{ MHz}$
Inband input 1dB-compression point	IP_{1dB}	3	7	–	dBm	$f = 2000\text{ MHz}$
Inband input 3 rd -order intercept point ¹	IIP_3	13	18	–	dBm	$f_1 = 2000\text{ MHz}, f_2 = f_1 + 1\text{ MHz}$
Transient time between ON mode and Bypass mode	t_S	–	1	3	μs	
Phase discontinuity between ON mode and Bypass mode	–	-6	–	6	$^{\circ}$	Part to part variation after compensation in Base Band with constant value

¹Input power = -15 dBm for each tone

5 RF Characteristics Highband

Table 6: RF Characteristics in ON Mode at $T_A = 25\text{ }^{\circ}\text{C}$, $V_{DD} = 2.8\text{ V}$, not used RX ports terminated with 50 Ohm

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Insertion power gain	$ S_{21} ^2$	11.8	13.3	14.8	dB	$f = 2500\text{ MHz}$
Noise figure, $Z_S = 50\text{ }\Omega$	NF	–	0.85	1.4	dB	$f = 2500\text{ MHz}$
Input return loss	RL_{in}	10	17	–	dB	$f = 2500\text{ MHz}$
Output return loss	RL_{out}	6	9	–	dB	$f = 2500\text{ MHz}$
Reverse isolation RFO to RX port	$1/ S_{12} ^2$	22	27	–	dB	$f = 2500\text{ MHz}$
Isolation RX to RX port, adjacent	ISO	21	26	–	dB	$f = 2500\text{ MHz}$
Isolation RX to RX port, non-adjacent	ISO	25	30	–	dB	$f = 2500\text{ MHz}$
Isolation RX to RFO port	ISO	23	28	–	dB	$f = 2500\text{ MHz}$
Inband input 1dB-compression point	IP_{1dB}	-15	-11	–	dBm	$f = 2500\text{ MHz}$
Inband input 3 rd -order intercept point ¹	IIP_3	-6	-1	–	dBm	$f_1 = 2500\text{ MHz}, f_2 = f_1 + 1\text{ MHz}$

Continued on next page

¹Input power = -30 dBm for each tone

GPIO Specification

Table 6: RF Characteristics – Continued from previous page

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Stability	k	> 1	–	–		$f = 20 \text{ MHz} - 10 \text{ GHz}$

Table 7: RF Characteristics in Bypass Mode at $T_A = 25^\circ\text{C}$, $V_{DD} = 2.8 \text{ V}$, not used RX ports terminated with 50 Ohm

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Insertion power gain	$ S_{21} ^2$	-7.3	-6.3	-5.3	dB	$f = 2500 \text{ MHz}$
Noise figure, $Z_S = 50 \Omega$	NF	–	6.3	7.3	dB	$f = 2500 \text{ MHz}$
Input return loss	RL_{in}	4	7	–	dB	$f = 2500 \text{ MHz}$
Output return loss	RL_{out}	8	11	–	dB	$f = 2500 \text{ MHz}$
Inband input 1dB-compression point	IP_{1dB}	4	8	–	dBm	$f = 2500 \text{ MHz}$
Inband input 3 rd -order intercept point ¹	IIP_3	16	21	–	dBm	$f_1 = 2500 \text{ MHz}, f_2 = f_1 + 1 \text{ MHz}$
Transient time between ON mode and Bypass mode	t_S	–	1	3	μs	
Phase discontinuity between ON mode and Bypass mode	–	-6	–	6	$^\circ$	Part to part variation after compensation in Base Band with constant value

¹Input power = –15 dBm for each tone

6 GPIO Specification

Table 8: Modes of Operation (Truth Table)

		Control Inputs		
State	Mode	GPIO1	GPIO2	GPIO3
1	Off	0	0	0
2	RX2 Bypass	0	0	1
3	RX1 Bypass	0	1	1
4	RX3 Bypass	0	1	0
5	Off	1	0	0
6	RX2 On	1	0	1
7	RX1 On	1	1	1
8	RX3 On	1	1	0

7 Application Information

Pin Configuration and Function

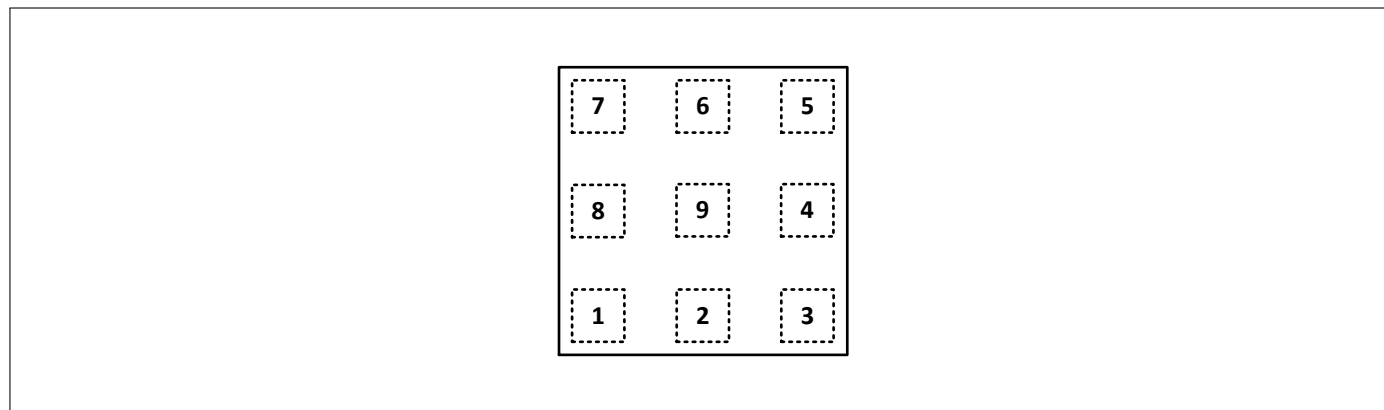


Figure 2: BGM13HBA9 Pin Configuration (top view)

Table 9: Pin Definition and Function

Pin No.	Name	Function
1	GPIO2	Control pin 2
2	VDD	Power supply
3	RFO	RF output port
4	GPIO1	Control pin 1
5	GPIO3	Control pin 3
6	RX3 ¹	RF input port 3
7	RX2 ¹	RF input port 2
8	RX1 ¹	RF input port 1
9	GND	Ground

¹ Need to be terminated with 50 Ohm if not used

Application Information

Application Board Configuration

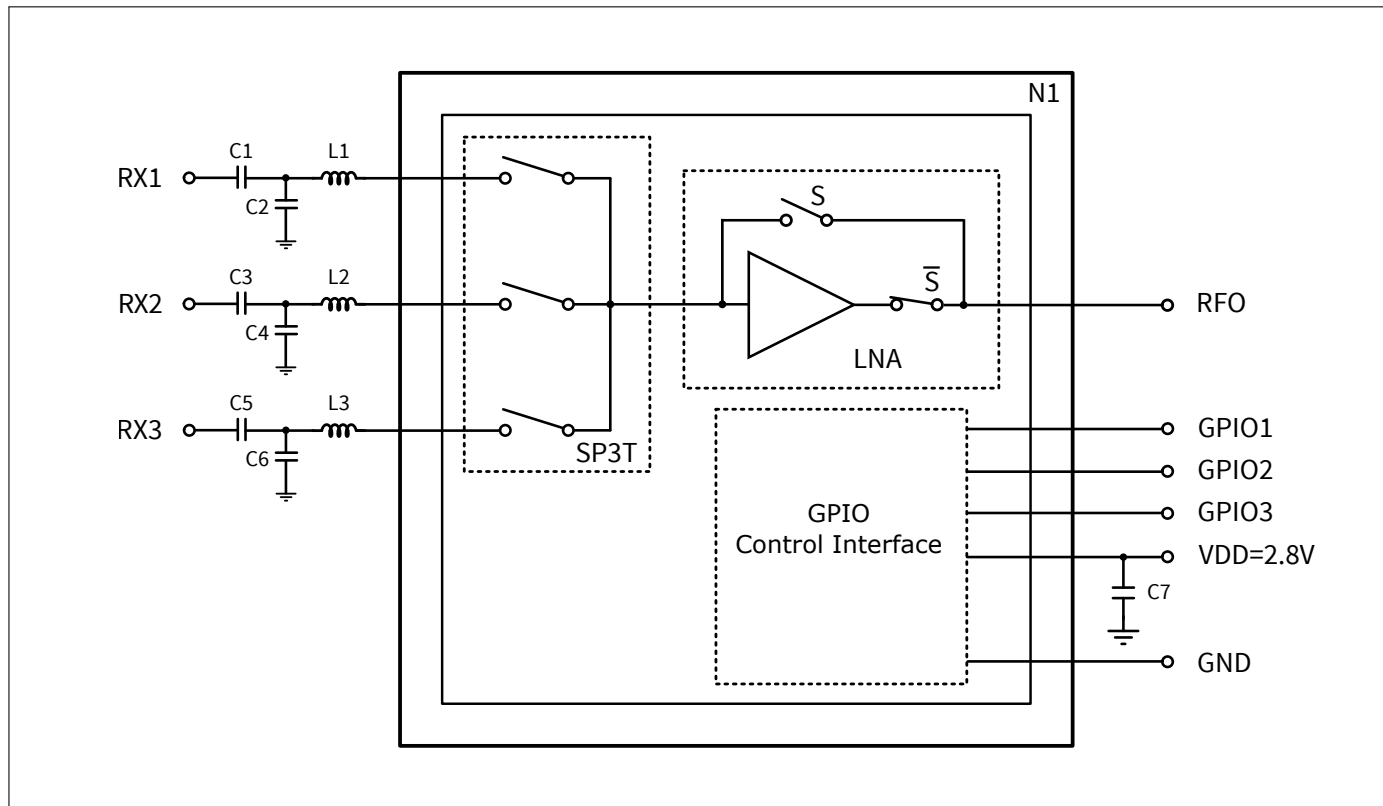


Figure 3: BGM13HBA9 Application Schematic

Table 10: Bill of Materials Table

Name	Value	Package	Manufacturer	Function
C1	1nF	0402	Various	DC block
C2	1.2pF	0402	Various	Input matching ¹
C3	1nF	0402	Various	DC block
C4	1.2pF	0402	Various	Input matching ¹
C5	1nF	0402	Various	DC block
C6	1.2pF	0402	Various	Input matching ¹
C7	$\geq 10\text{nF}$	0402	Various	RF Bypass ²
L1	4.3nH	0402	Murata LQW15 type	Input matching ¹
L2	4.3nH	0402	Murata LQW15 type	Input matching ¹
L3	4.3nH	0402	Murata LQW15 type	Input matching ¹
N1	BGM13HBA9	ATSLP-9-1	Infineon	LNA Multiplexer Module

¹The matching elements must be optimized with reference to the frequency band of interest. Each band can be arbitrarily assigned to an RF port.

²RF bypass recommended to mitigate power supply noise.

BGM13HBA9

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Package Information

8 Package Information

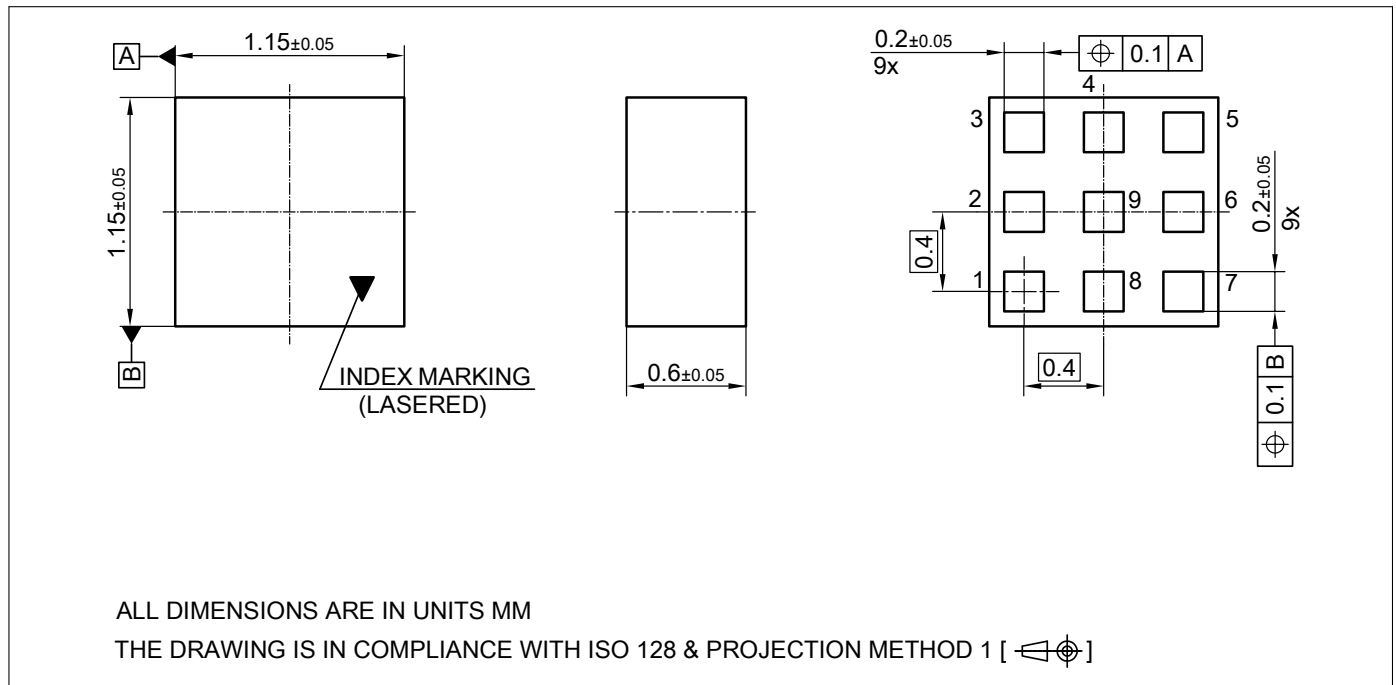


Figure 4: ATSLP-9-1 Package Outline (top, side and bottom views)

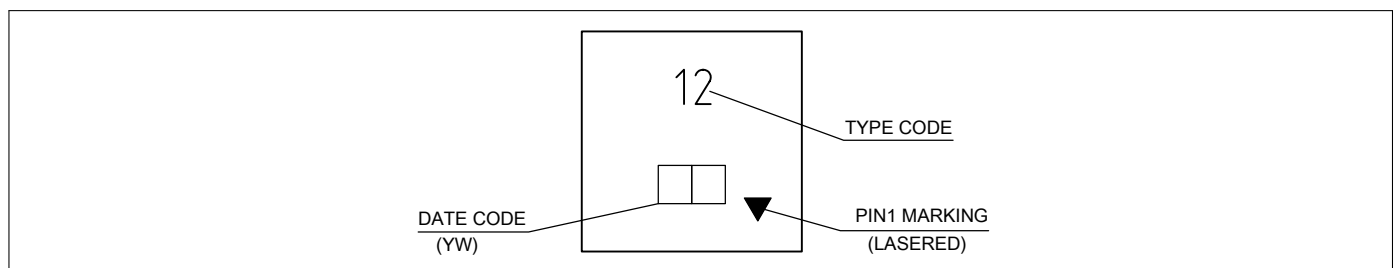


Figure 5: Marking Specification (top view)

Table 11: Year date code marking - digit "Y"

Year	"Y"	Year	"Y"	Year	"Y"
2000	0	2010	0	2020	0
2001	1	2011	1	2021	1
2002	2	2012	2	2022	2
2003	3	2013	3	2023	3
2004	4	2014	4	2024	4
2005	5	2015	5	2025	5
2006	6	2016	6	2026	6
2007	7	2017	7	2027	7
2008	8	2018	8	2028	8
2009	9	2019	9	2029	9

Table 12: Week date code marking - digit "W"

Week	"W"	Week	"W"	Week	"W"	Week	"W"	Week	"W"
1	A	12	N	23	4	34	h	45	v
2	B	13	P	24	5	35	j	46	x
3	C	14	Q	25	6	36	k	47	y
4	D	15	R	26	7	37	l	48	z
5	E	16	S	27	a	38	n	49	8
6	F	17	T	28	b	39	p	50	9
7	G	18	U	29	c	40	q	51	2
8	H	19	V	30	d	41	r	52	3
9	J	20	W	31	e	42	s	53	M
10	K	21	Y	32	f	43	t		
11	L	22	Z	33	g	44	u		

BGM13HBA9

SP3T Low Noise Amplifier Multiplexer Module with Bypass

Package Information

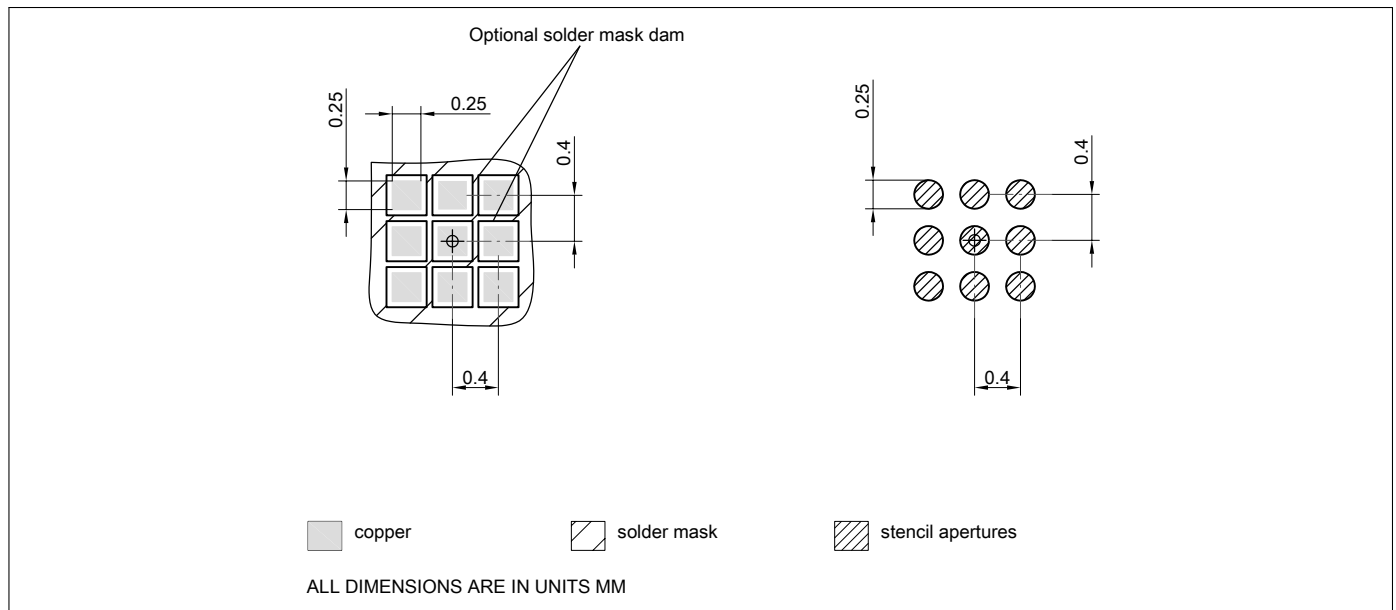


Figure 6: Footprint Recommendation

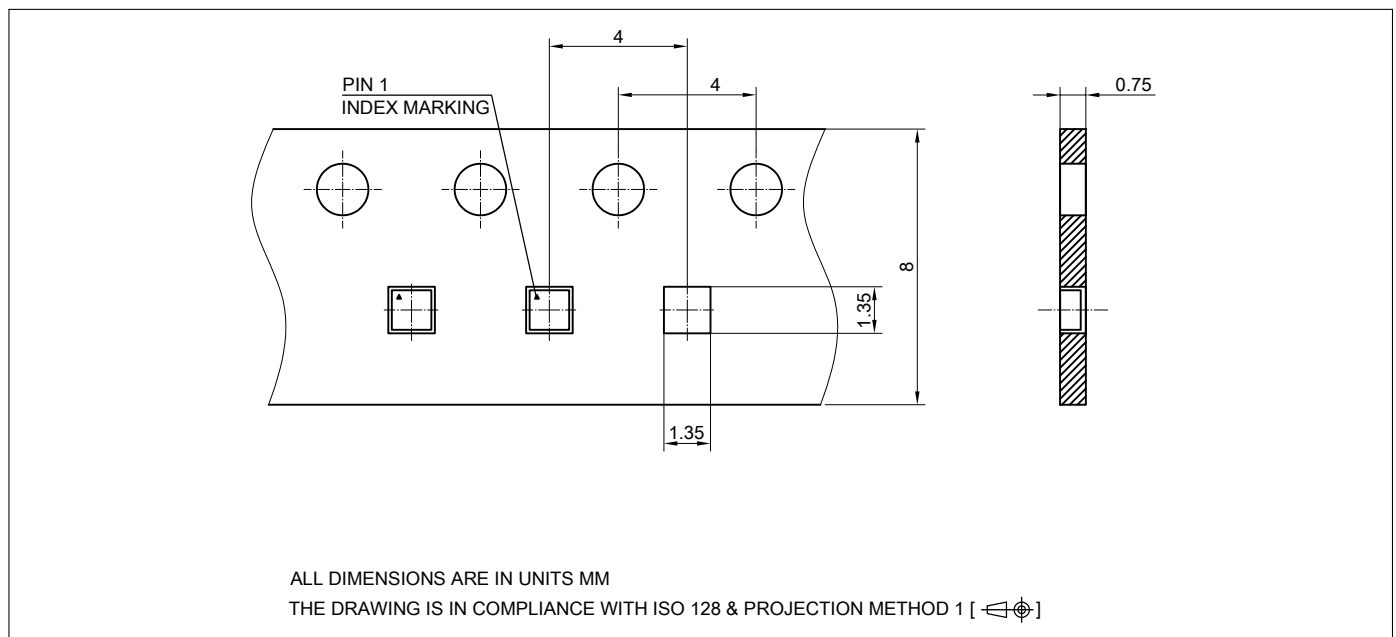


Figure 7: ATSLP-9-1 Carrier Tape

Revision History	
Previous Revision 2.0 - 2016-09-02	
Page or Item	Subjects (major changes since previous revision)
Revision 3.1, 2017-11-09	
2	Final marking added
3	Maximum ratings comment updated
3	ESD capability updated
4	DC characteristics updated
4-6	RF characteristics updated
5,6	1dB-compression point for bypass mode added
7	Footnote updated in Table 9
8	Application schematic drawing updated
8	Bill of materials table updated
9	Package outline drawing updated
9	Marking specification added
10	Date code description added in Tables 11 and 12
11	Footprint recommendation drawing updated
11	Carrier tape drawing added

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