

# AlGaAs SP2T Switch with Integrated Bias Network

## 2 - 22 GHz



**MASW-011129-DIE**  
Rev. V2

### Features

- Broad Bandwidth Specified up to 22 GHz
- Integrated DC Blocks and RF Bias Networks
- Low Insertion Loss / High Isolation
- Fast Switching Speed
- Fully Monolithic
- Low Current Consumption:  
-10 mA for Low Loss State  
+10 mA for Isolation State
- Die Size: 2.07 mm X 1.48 mm
- RoHS\* Compliant

### Applications

- Test & Measurement
- Broadband Communication Systems

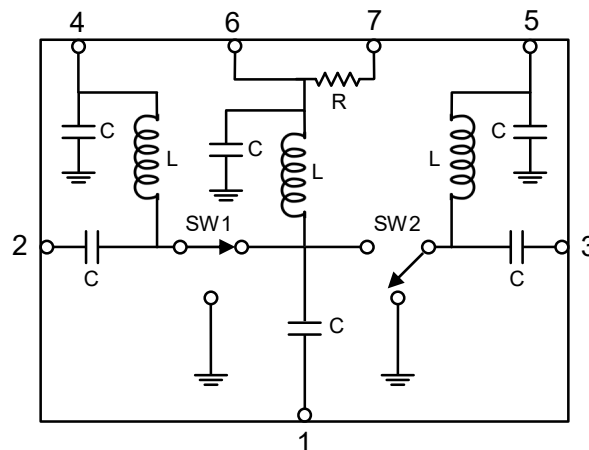
### Description

The MASW-011129-DIE is an SPDT PIN diode switch with integrated bias networks offered as bare die part. This broadband, reflective switch operates from 2 - 22 GHz and provides less than 1 dB insertion loss and 35 dB isolation.

The combination of broadband performance along with very fast switching (<10 ns) and excellent settling time make this device ideal for many applications, including test & measurement, and broadband communication systems.

The switch is fully passivated with silicon nitride and has an added polymer layer for scratch protection. The protective coating prevents damage to the junctions and the anode air-bridges during handling and assembly. The die has backside metallization to facilitate an epoxy die attach process.

### Functional Schematic



### Pin Configuration

Pad #	Function
1	RF Common
2	RF1
3	RF2
4	Bias 1
5	Bias 2
6	RF Common Bias (optional external resistor)
7	RF Common Bias

### Ordering Information

Part Number	Package
MASW-011129-DIE	Die in Gel Pack

\* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

# AlGaAs SP2T Switch with Integrated Bias Network

## 2 - 22 GHz



MASW-011129-DIE

Rev. V2

**Electrical Specifications:**  $T_A = +25^{\circ}\text{C}$ ,  $I_{DC} = \pm 10 \text{ mA}$ ,  $Z_0 = 50 \Omega$

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss	2 GHz	dB	-1.8	-1.1	-0.5
	6 GHz		-1	-0.5	0
	12 GHz		-1	-0.5	0
	18 GHz		-1.1	-0.6	-0.1
Input to Output Isolation	2 GHz	dB	—	-60	-50
	6 GHz			-50	-40
	12 GHz			-45	-35
	18 GHz			-40	-30
RF Common Return Loss	2 GHz	dB	—	-14	-10
	6 GHz			-16	-12
	12 GHz			-19	-15
	18 GHz			-27	-23
RF1, RF2 Return Loss	2 GHz	dB	—	-14	-10
	6 GHz			-16	-12
	12 GHz			-19	-15
	18 GHz			-20	-16
$P_{IN}$ at 0.1 dB Compression	$V_R = -2 \text{ V, @ } 2 \text{ GHz}$ $V_R = -5 \text{ V, @ } 2 \text{ GHz}$ $V_R = -10 \text{ V, @ } 2 \text{ GHz}$	dBm	—	22.0 26.5 28.0	—
Input IP3	2 Tone, 5 dBm/Tone, 5 MHz spacing, 2 - 18 GHz	dBm	—	50	—
$T_{RISE}$ , $T_{FALL}$	10% to 90% RF & 90% to 10% RF	ns	—	3	—
$T_{ON}$ , $T_{OFF}$	50% control to 90% RF & 50% control to 10% RF	ns	—	7	—

### Absolute Maximum Ratings<sup>1,2</sup>

Parameter	Absolute Maximum
Incident CW RF Power	30 dBm @ $V_R = -10 \text{ V}$
Forward Bias Current	20 mA
Reverse DC Bias Voltage	-50 V
Junction Temperature <sup>3</sup>	+150°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C

- Exceeding any one or combination of these limits may cause permanent damage to this device.
- MACOM does not recommend sustained operation near these survivability limits.
- Operating at nominal conditions with  $T_J \leq +150^{\circ}\text{C}$  will ensure MTTF >  $1 \times 10^6$  hours.

### Handling Procedures

Please observe the following precautions to avoid damage:

### Static Sensitivity

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM Class 1A devices.

# AlGaAs SP2T Switch with Integrated Bias Network

## 2 - 22 GHz



MASW-011129-DIE  
Rev. V2

### Truth Table & Bias Conditions

RF Common Path	Bias 1	Bias 2
RF1 Low Loss RF2 Isolation	$V_R = -10 \text{ V}^4$	$I_F = +10 \text{ mA}$
RF1 Isolation RF2 Low Loss	$I_F = +10 \text{ mA}$	$V_R = -10 \text{ V}^4$

4. Reverse bias voltage should be determined based on working conditions. For example,  $-10 \text{ V}$  @  $2 \text{ GHz}$ ,  $28 \text{ dBm}$  input power. For lower power applications, a less negative voltage can be used. R. Caverly and G. Hiller, "Establishing the Minimum Reverse Bias for a PIN Diode in a High Power Switch," IEEE Transactions on Microwave Theory and Techniques, Vol. 38, No. 12, December 1990. See Compression Power and Junction Temperature Performance curves for guidance.

### RF Common Bias Configuration:

Option #1: Biased using internal resistance

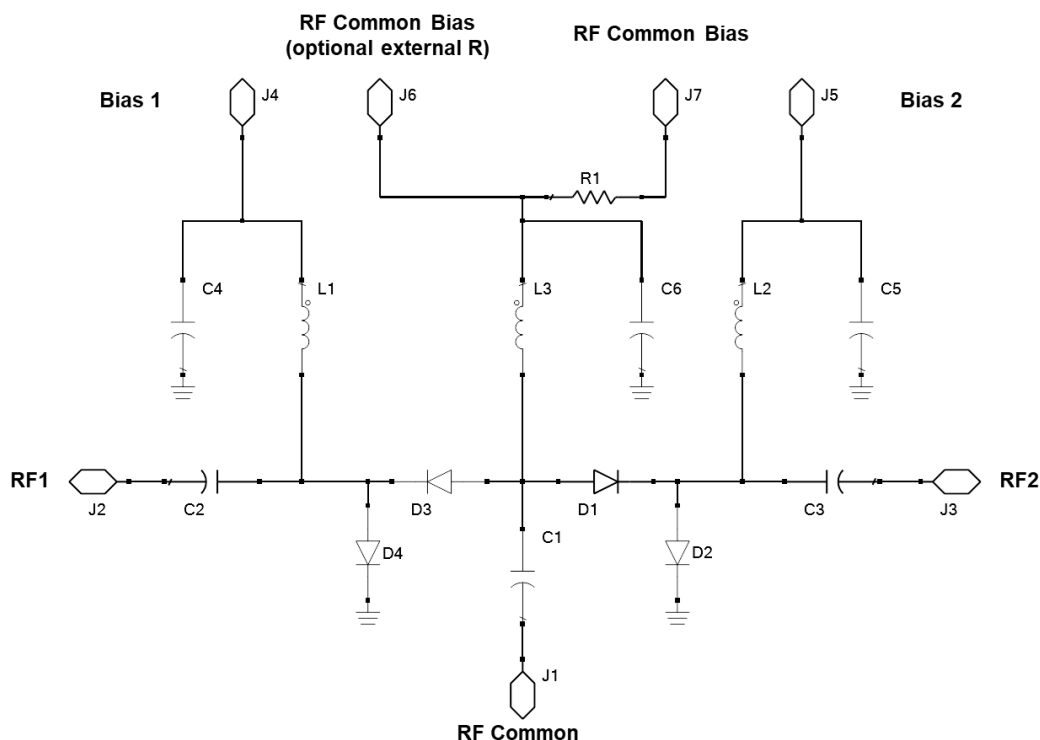
- J7 to ground
- J6 un-connected
- Set  $V_R$  to  $-2 \text{ V}^5$
- R1 value is  $57 \Omega$

Option #2: Biased using external resistance

- J6 to external resistor ( $R_{\text{BIAS}}$ ) to ground
- J7 un-connected
- $R_{\text{BIAS}} = (V_R - 1.4 \text{ V})/I_{\text{DC}}$

5.  $22 \text{ dBm}$  input power maximum.

### Circuit Schematic



# AlGaAs SP2T Switch with Integrated Bias Network

## 2 - 22 GHz

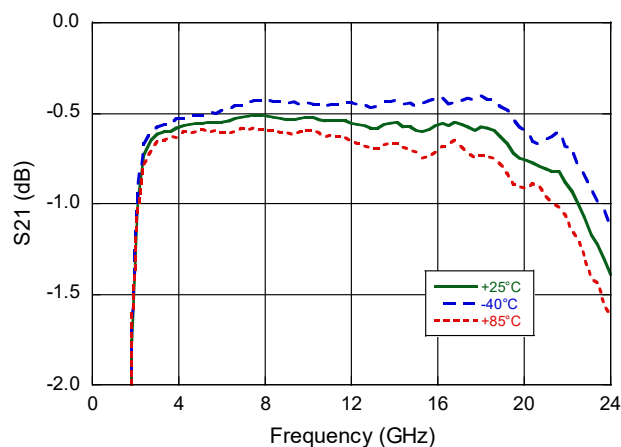


MASW-011129-DIE

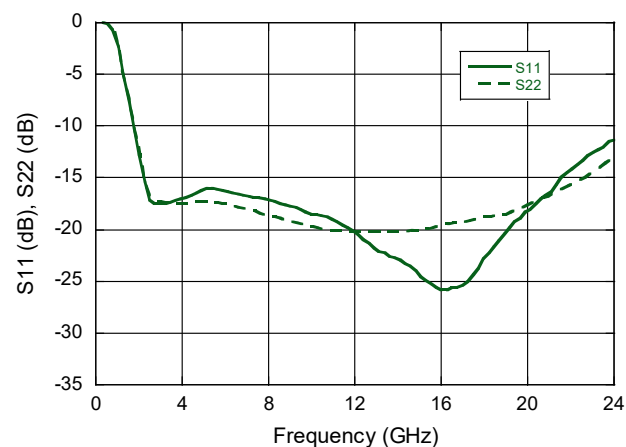
Rev. V2

**Typical RF Performance Curves, On-Wafer (RF1, RF2 Symmetrical):**  
**Test Conditions:  $V_R = -2$  V,  $I_F = +10$  mA,  $P_{IN} = -10$  dBm**

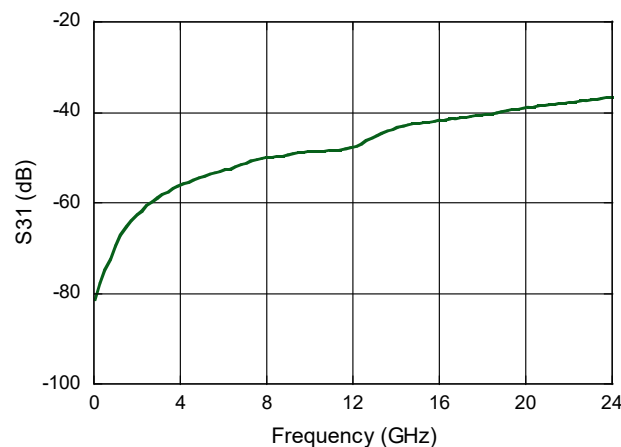
**Insertion Loss over Temperature**



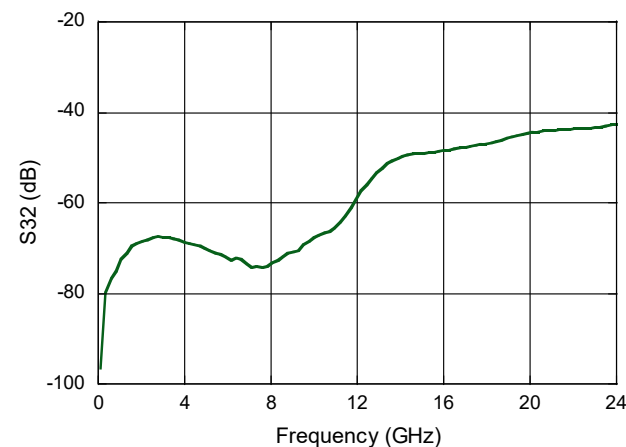
**Return Loss**



**Isolation (RF Common to RF2)**



**Isolation (RF1 to RF2)**



# AlGaAs SP2T Switch with Integrated Bias Network

## 2 - 22 GHz

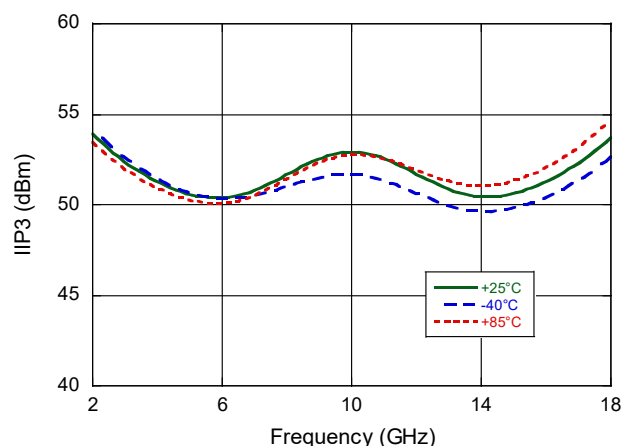


MASW-011129-DIE

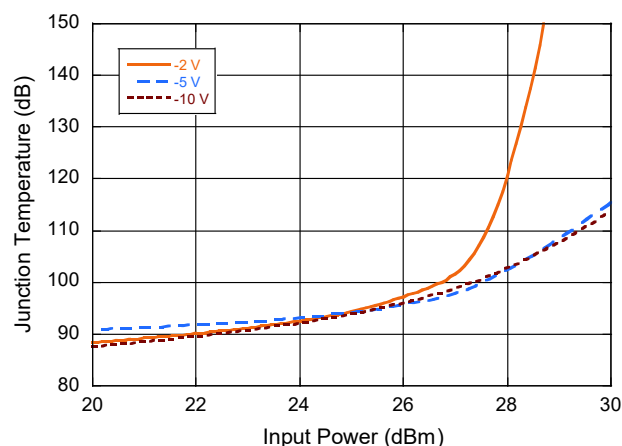
Rev. V2

### Typical RF Performance Curves, On-Board (RF1, RF2 Symmetrical)

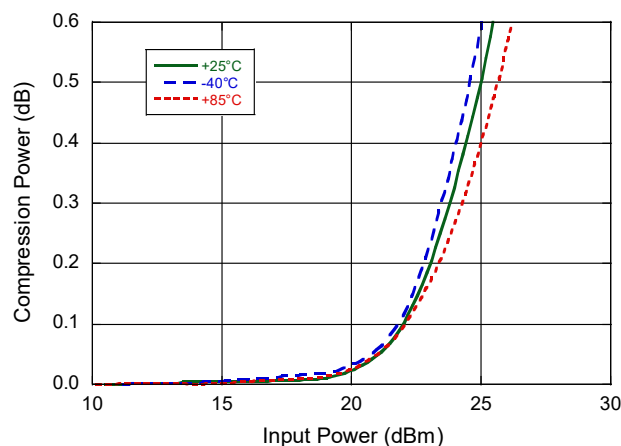
***IP3 over Temperature,  $P_{IN} = 5$  dBm per tone***



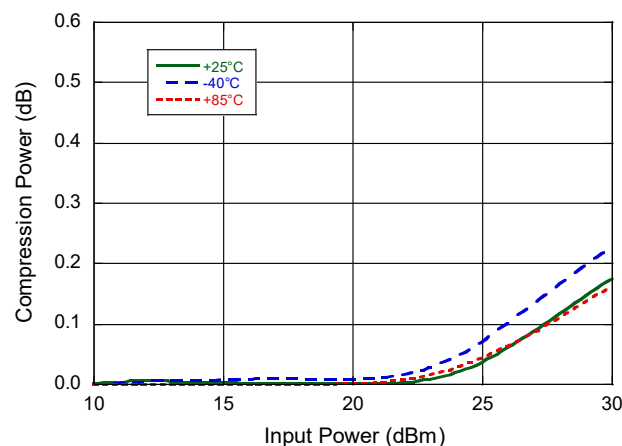
***Junction Temperature over  $V_R$  @ 2 GHz, +85°C***



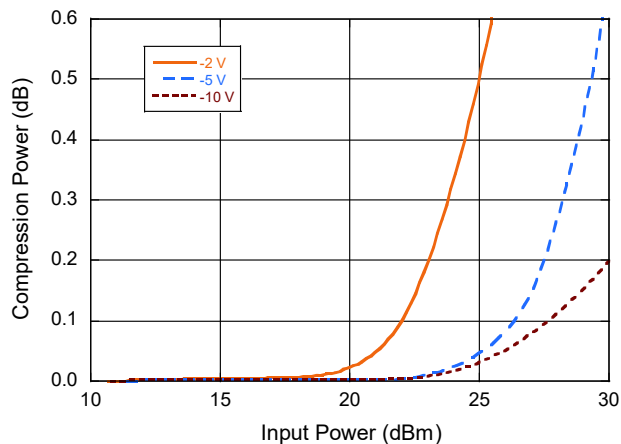
***Compression Power, over Temperature @ 2 GHz,  $V_R$  -2 V***



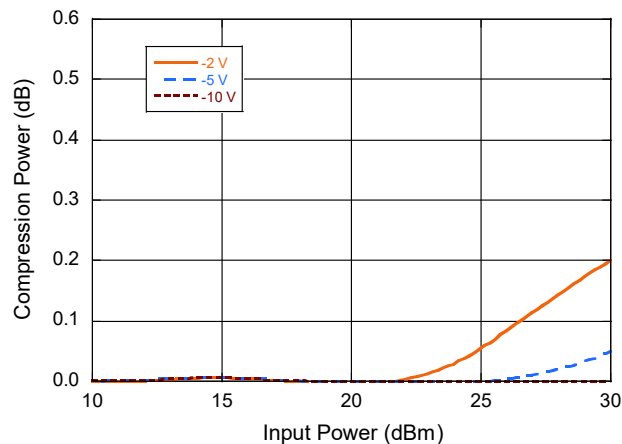
***Compression Power, over Temperature @ 18 GHz,  $V_R$  -2 V***



***Compression Power, over  $V_R$  @ 2 GHz, +25°C***



***Compression Power, over  $V_R$  @ 18 GHz, +25°C***



### Solder Die Attach

All die attach and bonding methods should be compatible with gold metal. Solder which does not scavenge gold, such as 80 Au/20 Sn or Indalloy #2, is recommended. Do not expose die to a temperature greater than 300°C for more than 10 seconds.

### Electrically Conductive Epoxy

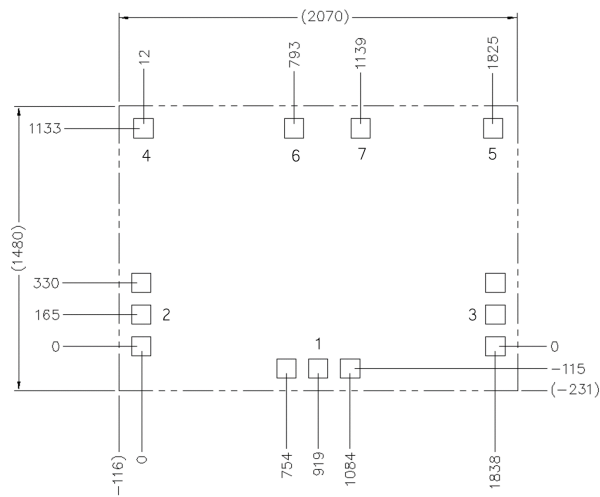
#### Die Attach

Assembly can be preheated to approximately 125°C. Use a controlled thickness of approximately 1 mils for best electrical conductivity and lower thermal resistance. A thin epoxy fillet should be visible around the perimeter of the chip after placement. Cure epoxy per manufacturer's schedule. For extended cure times, temperatures should be kept below 150°C.

### Wire / Ribbon Bonding

Wedge thermo compression bonding may be used to attach ribbons to the RF bonding pads. Gold ribbons should be at least 1/4 mil by 2 mil for lowest inductance. The same gold ribbon or 1 mil dia. gold wire is recommended for all DC pads.

### Die Outline Drawing<sup>6,7,8,9,10</sup>



6. Bond pad dimensions 1 - 7, 100  $\mu\text{m}$  x 100  $\mu\text{m}$ .
7. Unless otherwise specified, all dimensions shown are  $\mu\text{m}$  with a tolerance of  $\pm 5 \mu\text{m}$ .
8. Die thickness is 100  $\mu\text{m}$ ,  $\pm 10 \mu\text{m}$ .
9. Bond pad / backside metallization: Gold
10. Die size reflects sawn dimensions.

MACOM Technology Solutions Inc. ("MACOM"). All rights reserved.

These materials are provided in connection with MACOM's products as a service to its customers and may be used for informational purposes only. Except as provided in its Terms and Conditions of Sale or any separate agreement, MACOM assumes no liability or responsibility whatsoever, including for (i) errors or omissions in these materials; (ii) failure to update these materials; or (iii) conflicts or incompatibilities arising from future changes to specifications and product descriptions, which MACOM may make at any time, without notice. These materials grant no license, express or implied, to any intellectual property rights.

THESE MATERIALS ARE PROVIDED "AS IS" WITH NO WARRANTY OR LIABILITY, EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHT, ACCURACY OR COMPLETENESS, OR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

MACOM:

MASW-011129-DIE