AlGaAs SP2T Switch with Integrated Bias Network 2 - 22 GHz

MASW-011206
Rev. V1

Features

- Insertion Loss: 0.7 dB @ 18 GHz
- Isolation: 39 dB @ 18 GHz
- Integrated DC Blocks and RF Bias Networks
- Fast Switching Speed
- Fully Monolithic
- Low Current Consumption:
  -10 mA for Low Loss Path
  +10 mA for Isolation Path
- Lead-Free 4 mm 24 lead AQFN
- RoHS* Compliant

Applications

- Test & Measurement
- Broadband Communication Systems

Description

The MASW-011206 is an SPDT PIN diode switch with integrated bias networks offered in lead-free 4 x 4 mm QFN surface mount plastic package. This broadband, reflective switch operates from 2 - 22 GHz and provides less than 1 dB insertion loss and 38 dB isolation.

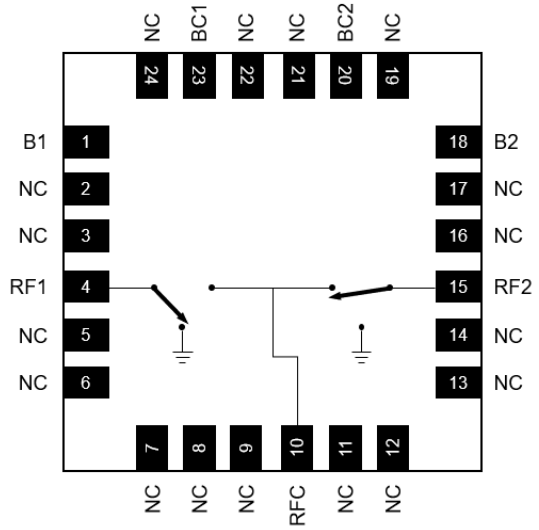
The combination of broadband performance along with very fast switching and excellent settling time make this device ideal for many applications, including test & measurement, and broadband communication systems.

Ordering Information[1]

Part Number	Package
MASW-011206-TR0500	500 piece reel
MASW-011206-SMB	Sample Board

1. Reference Application Note M513 for reel size information.

Functional Schematic



Pin Configuration[2]

Pin #	Pin Name	Description
2,3, 5-9, 11-14, 16, 17, 19, 21, 22, 24	NC	No Connect
1	B1	DC Bias 1
4	RF1	RF Port 1
10	RFC	RF Common Port
15	RF2	RF Port 2
18	B2	DC Bias 2
20	BC2	Common Bias with 400 Ω resistor
23	BC1	Common Bias without resistor
25	-	Paddle[3]

2. MACOM recommends connecting unused package pins to ground.
3. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

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

Electrical Specifications: T_A = +25°C, I_{DC} = +/-10 mA, V_R = -10 V, Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss	2 GHz 6 GHz 12 GHz 18 GHz 22 GHz	dB	—	1.1 0.7 0.6 0.7 0.9	1.5 1.2 1.0 1.2 1.6
Input to Output Isolation	2 GHz 6 GHz 12 GHz 18 GHz 20 GHz	dB	47 43 36 37 33	60 47 41 39 38	—
RF Common / Output Return Loss	2 GHz 6 GHz 12 GHz 18 GHz 22 GHz	dB	—	13 13 25 27 22	—
P_{IN} at 0.1 dB Compression	V_R = -10 V, @ 2 GHz V_R = -10 V, @ 10 GHz V_R = -10 V, @ 18 GHz V_R = -5 V, @ 2 GHz V_R = -5 V, @ 10 GHz V_R = -5 V, @ 18 GHz	dBm	—	26 35 35 25 30 31	—
Input IP3	5 MHz Offset, Pin/tone = 15 dBm, V_R = -10 V	dBm	—	47	—
T_{RISE}	10% to 90% RF @ 5 GHz, V_R = -5 V	ns	—	23	—
T_{FALL}	90% to 10% RF @ 5 GHz, V_R = -5 V	ns	—	18	—
T_{ON}	50% control to 90% RF @ 5 GHz, V_R = -5 V	ns	—	25	—
T_{OFF}	50% control to 10% RF @ 5 GHz, V_R = -5 V	ns	—	19	—

Absolute Maximum Ratings[4,5]

Parameter	Absolute Maximum
Incident C.W. RF Power	31 dBm @ 2 GHz 33 dBm @ 18 GHz
Bias Current	±20 mA
Junction Temperature[6]	+150°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C

4. Exceeding any one or combination of these limits may cause permanent damage to this device.
5. MACOM does not recommend sustained operation near these survivability limits.
6. Operating at nominal conditions with $T_J \leq$ +150°C will ensure MTTF > 1 x 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 devices.

Truth Table & Bias Conditions

RF Common Path	Bias 1	Bias 2
RF1 Low Loss RF2 Isolation	V_R = -10 V[7]	I_F = +10 mA
RF1 Isolation RF2 Low Loss	I_F = +10 mA	V_R = -10 V[7]

7. Reverse bias voltage should be determined based on working conditions. For example, -10 V @ 2 GHz, 26 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.

The design of the MASW-011206 SP2T switch allows two options for biasing of its series PIN diodes:

- For small signal operation with input power less than 26 dBm, the reverse bias voltage applied to bias port B1/B2 can be -5.5 V. In this case, port BC2 (pin 20) should be connected to ground and BC1 (pin 23) should be unconnected. This configuration will result in -10 mA (nominal) current through the series PIN diode on the low-insertion-loss side of the switch.
- For operation with higher input power (26 dBm or greater), -10 V bias voltage should be applied to the bias port on the insertion loss side of the switch. In this case, bias port BC2 must be unconnected and an external resistor must be connected between bias port BC1 and ground. The value of the external resistor, R_{BIAS}, is given by:

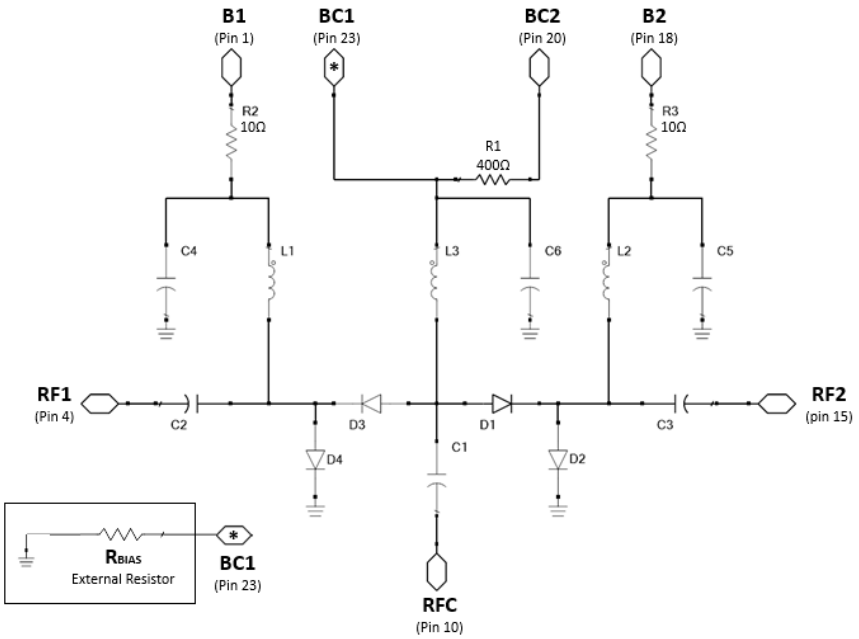
$$R_{BIAS} \approx \frac{(|V_R| - 1.4\ V)}{|I_{BIAS}|} - 10\ \Omega$$

For example, if V_R = -10 V:

$$R_{BIAS} \approx \frac{(|V_R| - 1.4\ V)}{|I_{BIAS}|} - 10\ \Omega = \frac{(|-10\ V| - 1.4\ V)}{|0.010\ A|} - 10\ \Omega = 850\ \Omega$$

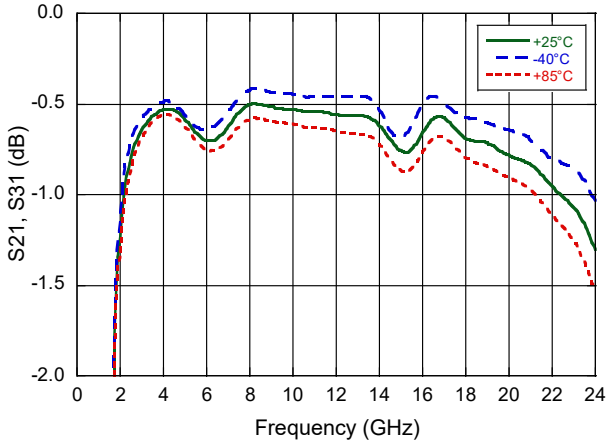
- For either biasing option, a +10 mA bias current, recommended compliance voltage equal to 2 V, should be applied to the bias port on the isolation side of the switch.

Circuit Schematic

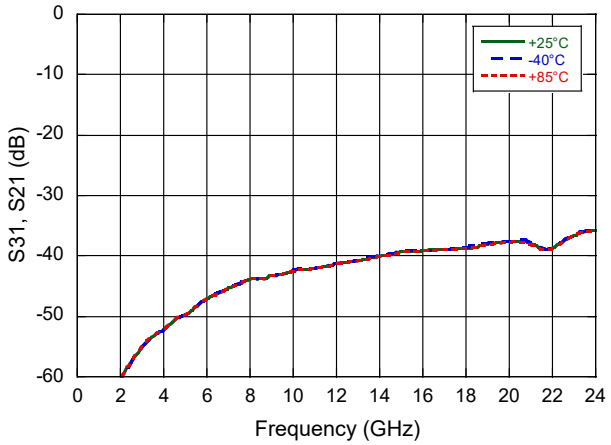


Typical Performance Curves: Board Loss Removed, I_{DC} = +/-10 mA, Z_0 = 50 Ω

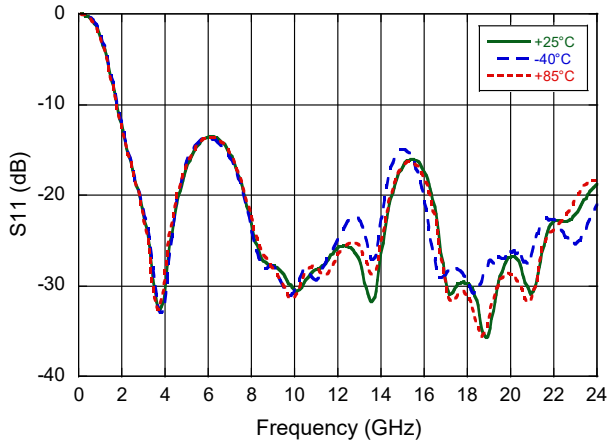
Insertion Loss, (S21, S31) over Temperature



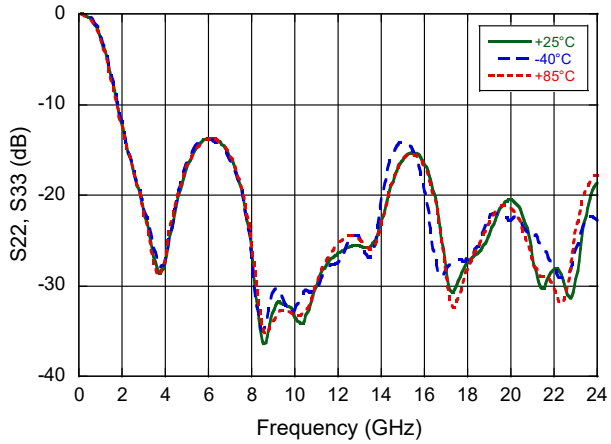
Isolation (S31, S21), over Temperature



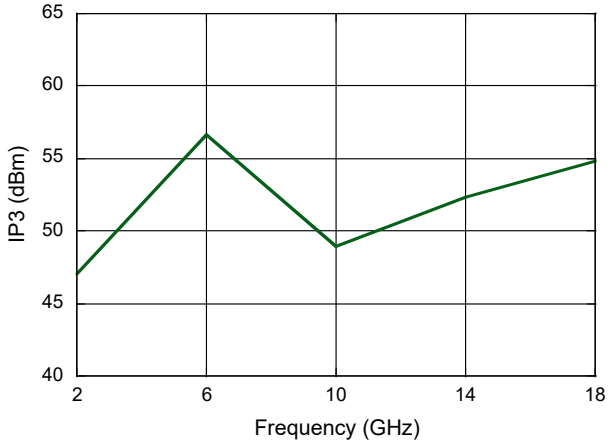
Common Return Loss (S11), over Temperature



Output Return Loss (S22, S33), over Temperature

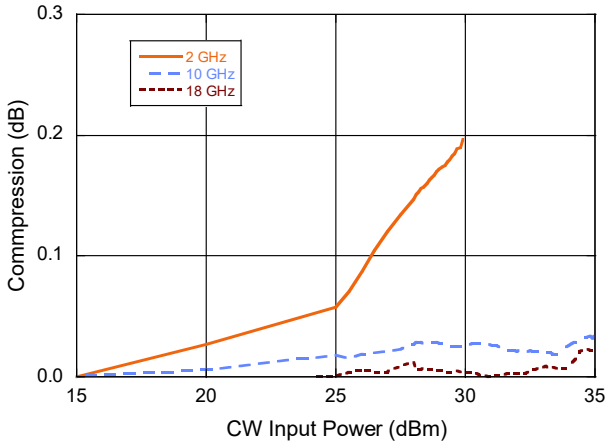


IP3 @ +25˚C, P_{IN} = 15 dBm per tone

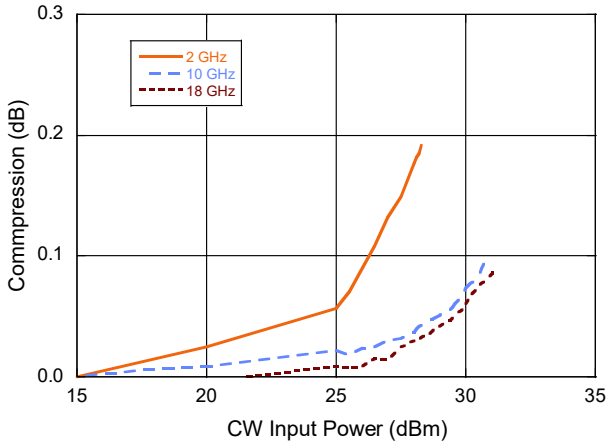


Typical Performance Curves: I_{DC} = +/-10 mA, Z_0 = 50 Ω, +25°C

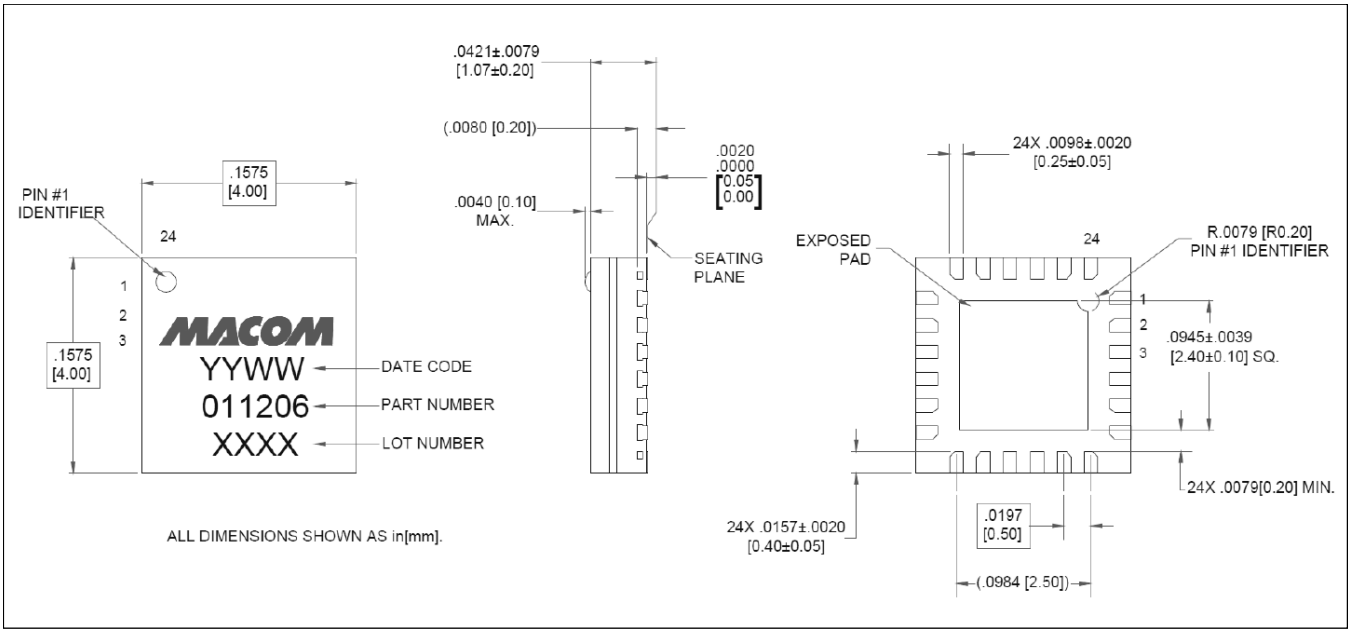
Compression Power over Frequency, V_R -10 V



Compression Power over Frequency, V_R -5 V



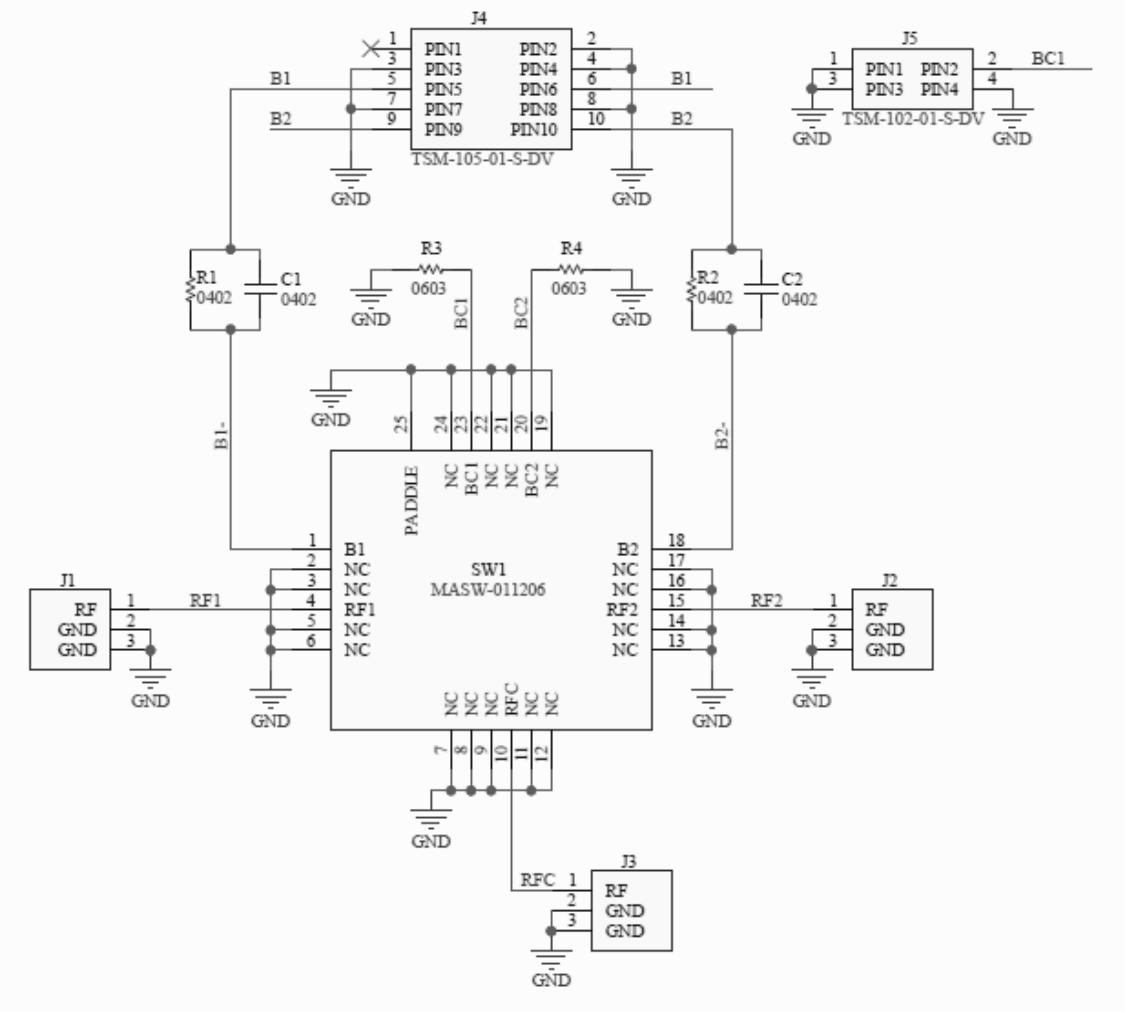
Lead-Free 4 mm 24-Lead AQFN Package†



† Reference Application Note S2083 for lead-free solder reflow recommendations.
Meets JEDEC moisture sensitivity level (MSL) 1 requirements.
Plating is NiPdAuAg

Application Section

Sample Board Schematic



Component Designator	Description	P/N
J1-J3	2.92 mm - Southwest Microwave connector	1092-01A-6
J4	Connector Header Surface Mount 10 position 0.100" (2.54 mm)	TSM-105-01-S-DV
R1, R2	SMD Resistor (0 Ω 0402 Chip Resistor)	PT-0020759
R3	SMD Resistor (845 Ω 0603 Chip Resistor)	CRCW0603845RFKEAHP
R4, C1, C2, J5	Do not populate	