AlGaAs SP3T Switch with Integrated Bias Network
2 - 18 GHz

Features

- Insertion Loss: 0.8 dB @ 18 GHz
- Isolation: 30 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 Each Isolation Path
- Lead-Free 3 mm, 16-Lead QFN
- RoHS* Compliant

Applications

- Test & Measurement
- Broadband Communication Systems

Description

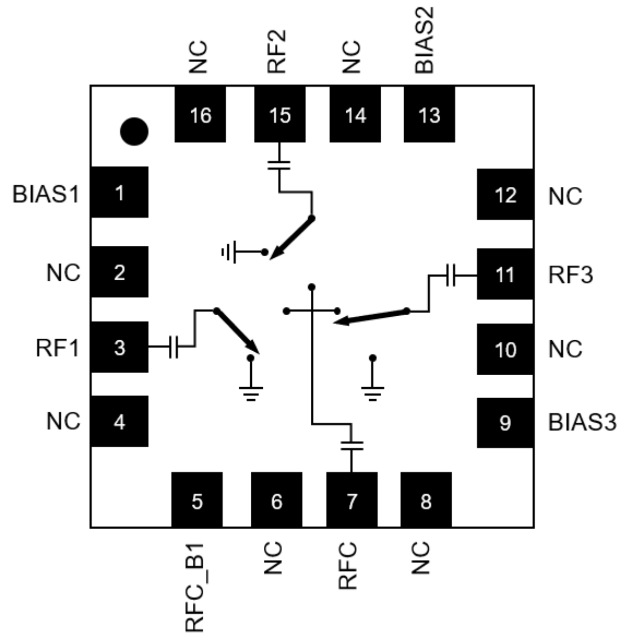
The MASW-011174 is an SP3T PIN diode switch with integrated bias networks offered in lead-free 3 x 3 mm QFN surface mount plastic package. This broadband, reflective switch operates from 2 - 18 GHz and provides 0.8 dB insertion loss and 30 dB isolation @ 18 GHz.

The combination of broadband performance along with very fast switching (<25 ns) and excellent settling time makes this device ideal for many applications, including Test & Measurement and broadband communication systems.

Ordering Information

Part Number	Package
MASW-011174-TR0500	500 pc tape and reel
MASW-011174-SMB	Sample Test Board

Functional Schematic



Pin Configuration[1]

Pin #	Pin Name	Description
2, 4, 6, 8, 10, 12,14,16	NC	No Connect
1	BIAS1	RF1 DC Bias
3	RF1	RF Input/Output 1
5	RFC_B1	RF Common Bias
7	RFC	RF Common
9	BIAS3	RF3 DC Bias
11	RF3	RF Input/Output 3
13	BIAS2	RF2 DC Bias
15	RF2	RF Input/Output 2
17	-	Paddle[2]

1. MACOM recommends connecting unused package pins to ground.
2. 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 11 GHz 18 GHz	dB	—	1.1 0.7 0.7 0.8	— 1.0 — —
Input to Output Isolation	2 GHz 6 GHz 11 GHz 18 GHz	dB	— 31 — —	46 39 32 30	—
RF Common Return Loss	2 GHz 6 GHz 11 GHz 18 GHz	dB	—	14 14 25 24	—
Output Return Loss	2 GHz 6 GHz 11 GHz 18 GHz	dB	—	14 14 25 24	—
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 33 33 15 19 30	—
Input IP3	5 MHz Offset, Pin/tone = 15 dBm, V_R = -10 V	dBm	—	>49	—
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[3,4]

Parameter	Absolute Maximum
Incident C.W. RF Power	30 dBm @ 2 GHz 34 dBm @ 18 GHz
Bias Current	±20 mA
Junction Temperature[5]	+150°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-65°C to +150°C

3. Exceeding any one or combination of these limits may cause permanent damage to this device.
4. MACOM does not recommend sustained operation near these survivability limits.
5. 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 HBM Class 1B (CDM Class C3) devices.

Truth Table & Bias Conditions

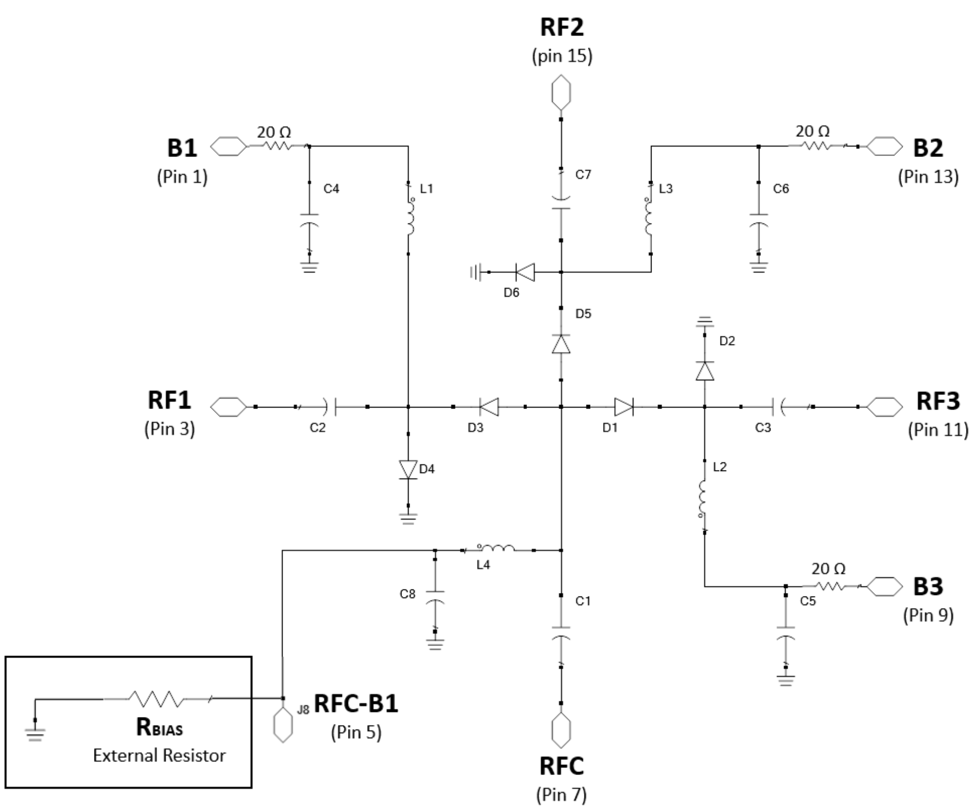
RF Common Path	Bias 1	Bias 2	Bias 3
RF1 Low Loss RF2 Isolation RF3 Isolation	V_R = -10 V[6]	I_F = +10 mA	I_F = +10 mA
RF1 Isolation RF2 Low Loss RF3 Isolation	I_F = +10 mA	V_R = -10 V[6]	I_F = +10 mA
RF1 Isolation RF2 Isolation RF3 Low Loss	I_F = +10 mA	I_F = +10 mA	V_R = -10 V[6]

6. 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.

RF Common Bias Configuration:

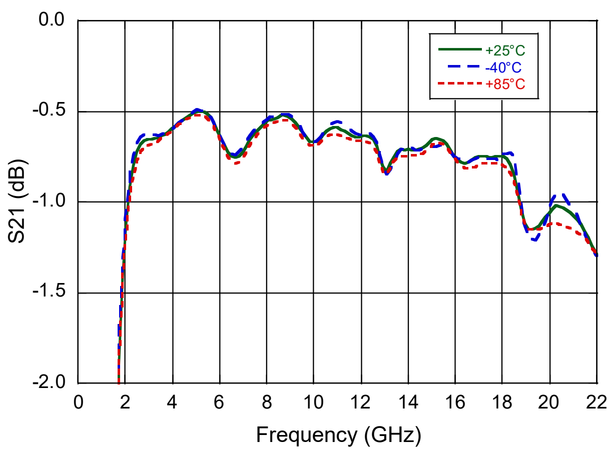
- Pin 5 (RFC-B1) to external resistor (R_{BIAS}) to ground
- $R_{BIAS} \approx (|V_R| - 1.4\ V) / |I_{DC}| - 20\ \Omega$
  - R_{BIAS} = 840 Ω for V_R = -10 V, I_{DC} = -10 mA
  - R_{BIAS} = 340 Ω for V_R = -5 V, I_{DC} = -10 mA

Circuit Schematic

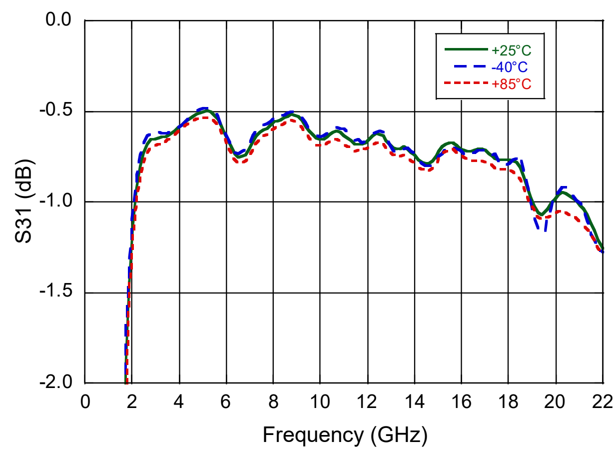


Typical Performance Curves: Board Loss Removed, I_{DC} = +/-10 mA, Z_0 = 50 Ω

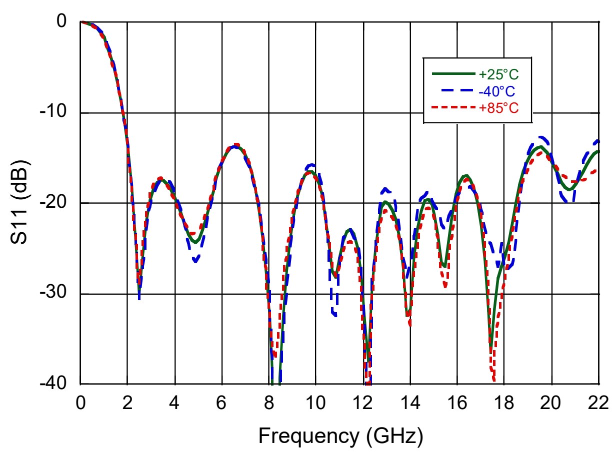
Insertion Loss, (S21) over Temperature, RF1$_{ON}$



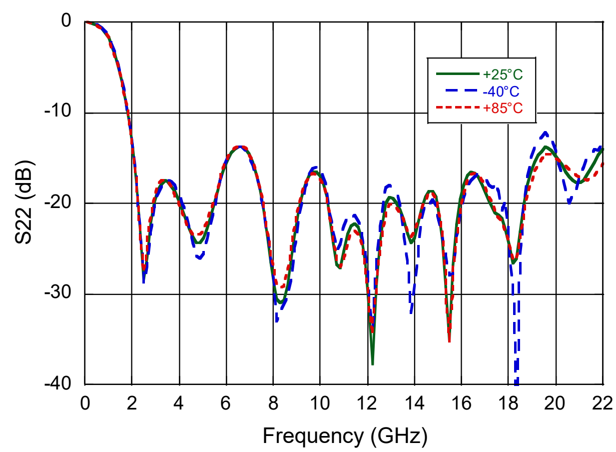
Insertion Loss, (S31) over Temperature, RF2$_{ON}$



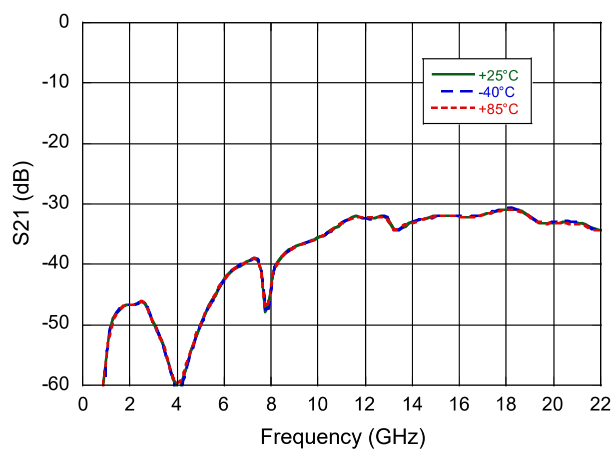
Input Return Loss (S11), over Temperature, RF1$_{ON}$



Output Return Loss (S22), over Temperature, RF1$_{ON}$

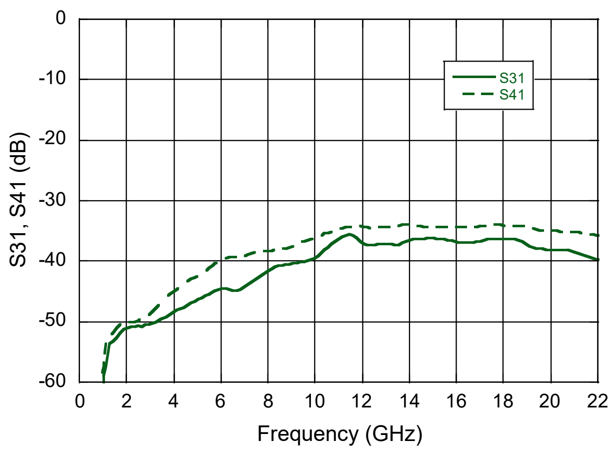


Isolation (S21), over Temperature, RF1$_{ON}$

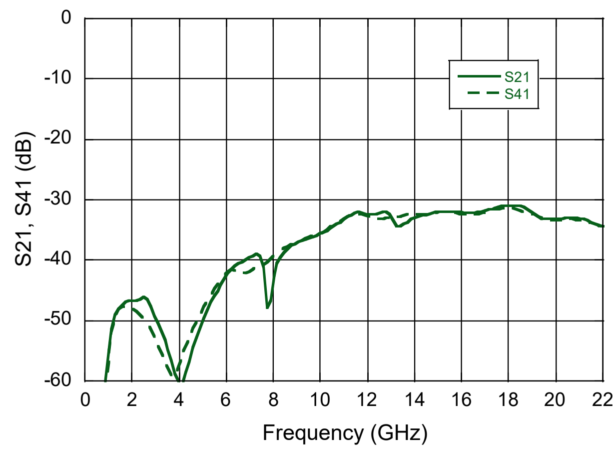


Typical Performance Curves: Board Loss Removed, I_{DC} = +/-10 mA, Z_0 = 50 Ω

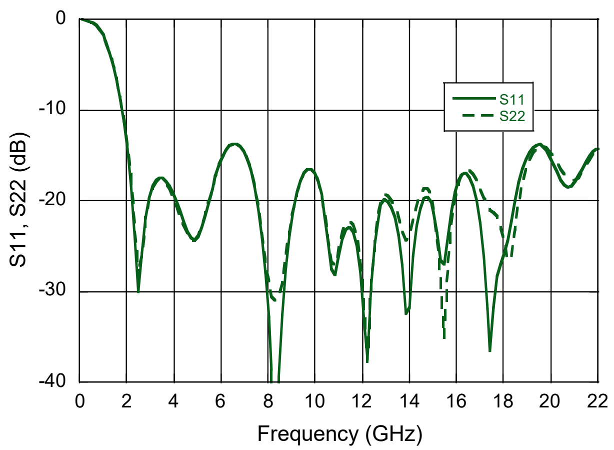
Isolation RFC to RF2 (S31) & RFC to RF3 (S41), $RF1_{ON}$



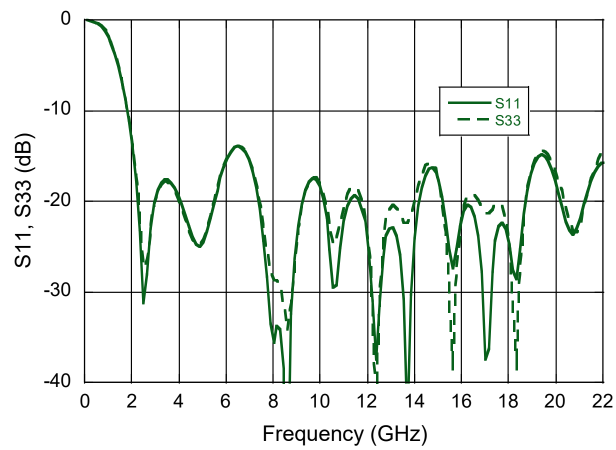
Isolation RFC to RF1 (S21) & RFC to RF3 (S41), $RF2_{ON}$



Return Loss, (S11, S22), $RF1_{ON}$

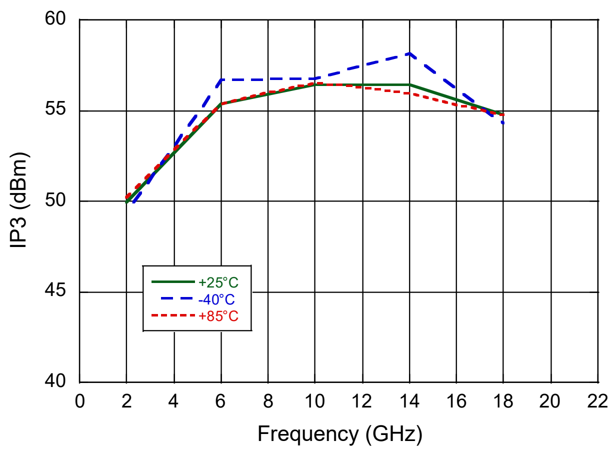


Return Loss, (S11, S33), $RF2_{ON}$

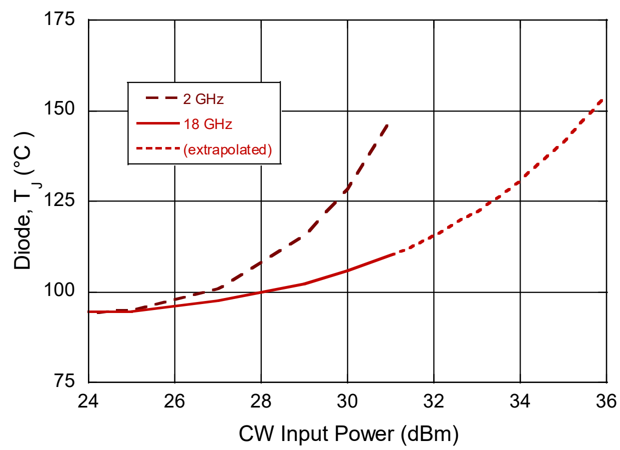


Typical Performance Curves: I_{DC} = +/-10 mA, Z_0 = 50 Ω

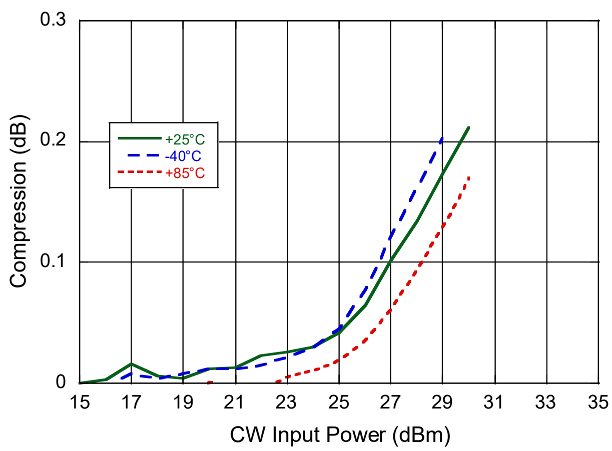
IP3 over Temperature, P_{IN} = 15 dBm per tone



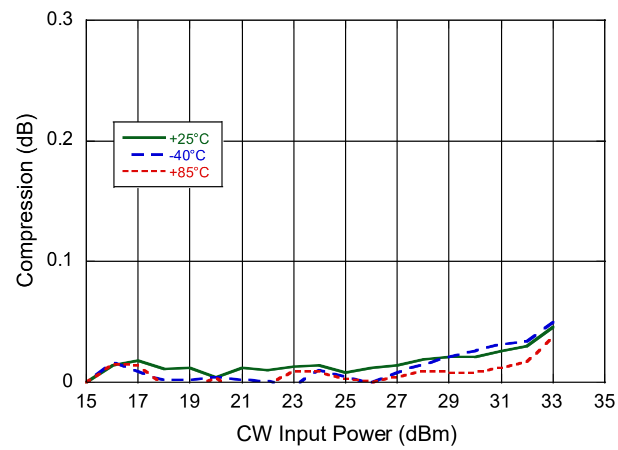
Junction Temperature @ V_R = -10 V, +85°C Baseplate[7]



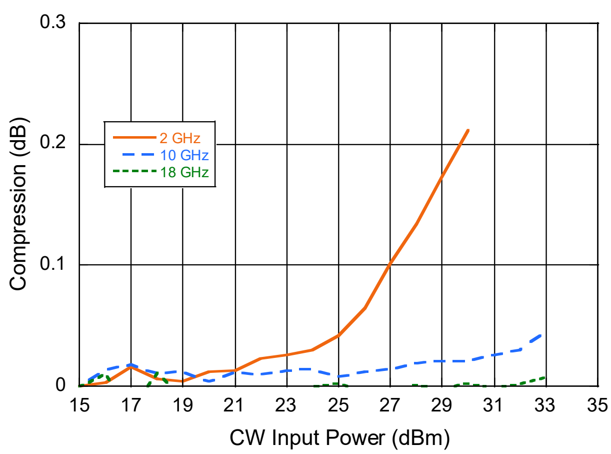
Compression Power over Temperature @ 2 GHz, V_R -10 V



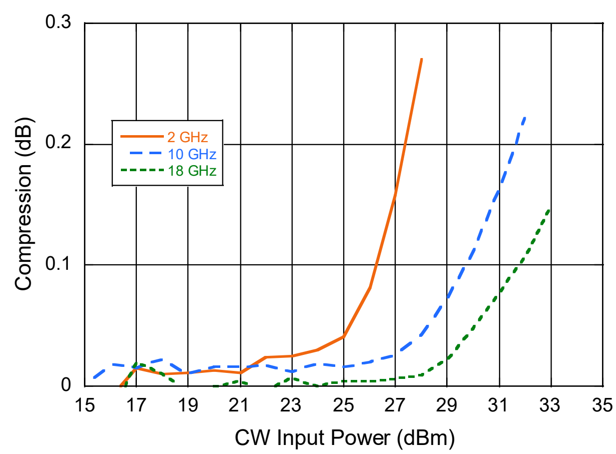
Compression Power over Temperature @ 10 GHz, V_R -10 V



Compression Power over Frequency, V_R -10 V, +25˚C

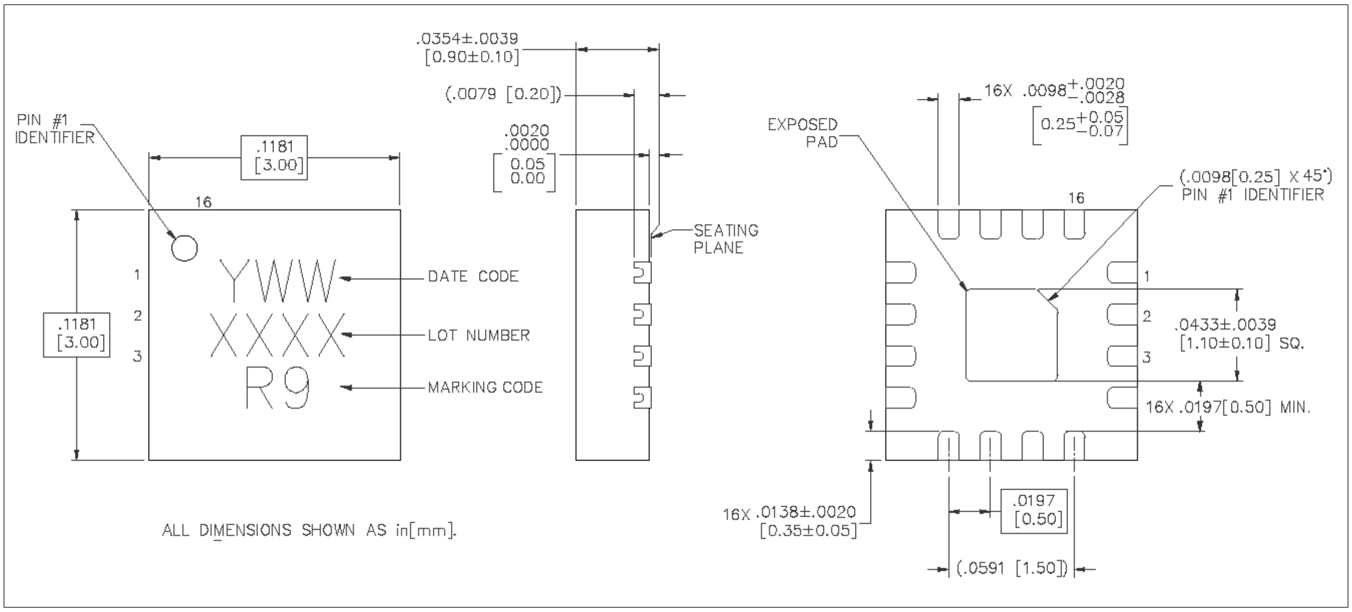


Compression Power over Frequency, V_R -5 V, +25˚C



7. Operating with Diode Junction Temperature ≤ +150°C will ensure MTTF > 1 x 10^6 hours.

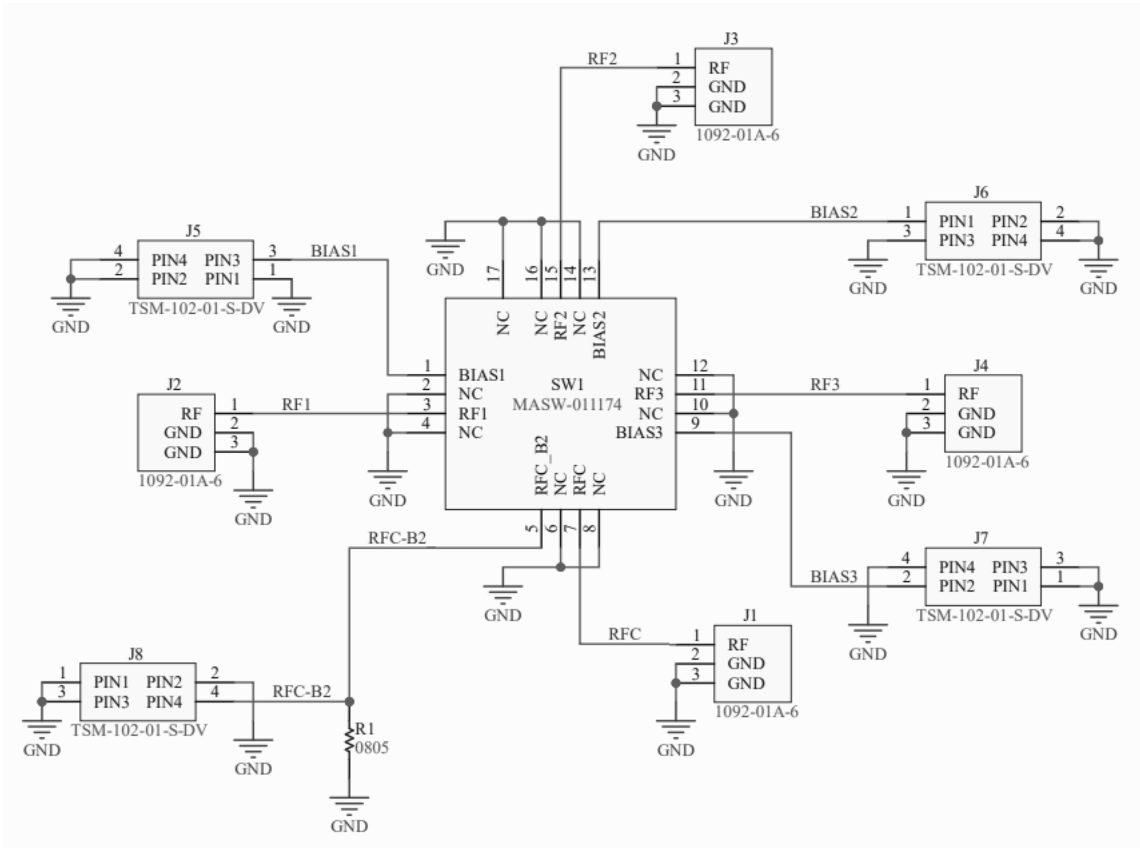
Package Outline Drawing†



† 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
RFC, RF1-3	2.92 mm—Southwest Microwave connector	1092-01A-6
B1-3, RFC-B1	Connector Header Surface Mount 4 position 0.100" (2.54 mm)	TSM-102-01-S-DV
R1	SMD Resistor (845 Ω 0805 Chip Resistor)	CRCW0805845RFKEA