Features

- Broad Bandwidth Specified up to 18 GHz
- Integrated Bias Network
- Low Insertion Loss / High Isolation
- Fully Monolithic Glass Encapsulated Chip
- Die Size: 2.76 x 2.24 mm
- RoHS* Compliant

Applications

- Aerospace & Defense
- EW
- ISM
- Radar
- Test & Measurement

Description

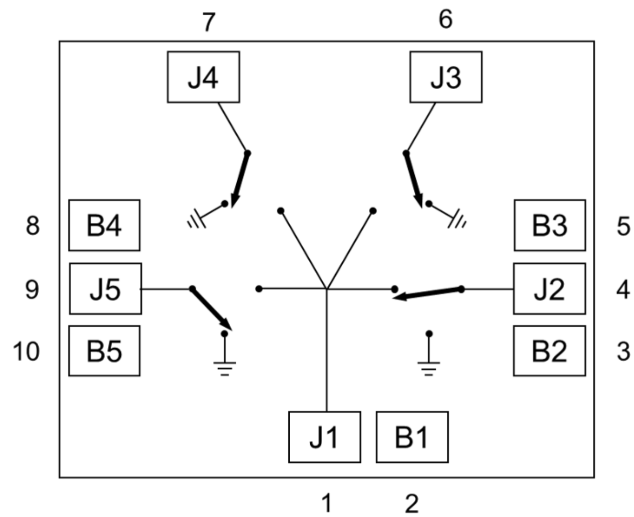
The MASW-011176 device is a SP4T broadband switch with integrated bias networks offered as a bare die part. Large bond pads facilitate the use of low inductance ribbon bonds, while gold backside metallization allows for manual or automatic chip bonding via 80/20 - Au/Sn, 62/36/2 - Sn/Pb/Ag solders or electrically conductive silver epoxy.

These high performance switches are suitable for use in multi-band ECM, Radar, and instrumentation control circuits where high isolation to insertion loss ratios are required. With a standard +5 V / -5 V, TTL controlled PIN diode driver, 70 ns switching speeds can be achieved.

Ordering Information

Part Number	Package
MASW-011176-DIE	Die in Gel Pack
MASW-011176-SMB	Sample Board

Functional Diagram



Pin Configuration[1]

Pin #	Pin Name	Description
1	J1	RF1 (Common Arm)
2	B1	RF1 Bias
3	B2	RF2 Bias
4	J2	RF2
5	B3	RF3 Bias
6	J3	RF3
7	J4	RF4
8	B4	RF4 Bias
9	J5	RF5
10	B5	RF5 Bias

1. The exposed metallization on the chip 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, Z_0 = 50 Ω, P_{IN} = -10 dBm, DC Control Current (I_{DC}) = 20 mA, Reverse Bias Voltage (V_{BIAS}) = -10 V (unless otherwise noted)

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss	2 GHz 6 GHz 12 GHz 18 GHz	dB	—	0.9 0.8 0.8 0.9	1.3 1.0 1.2 1.6
Input to Output Isolation	2 GHz 6 GHz 12 GHz 18 GHz	dB	50 50 40 30	65 60 60 45	—
Input Return Loss	2 - 18 GHz	dB	—	18	—
P_{IN} at 0.1 dB Compression	V_{BIAS} = -2 V, @ 2 GHz V_{BIAS} = -10 V, @ 2 GHz V_{BIAS} = -15 V, @ 2 GHz	dBm	—	20 31 33	—
Input IP3	2 Tone, P_{IN} = +15 dBm, 5 MHz spacing, 2 - 18 GHz	dBm	—	55	—
T_{RISE}, T_{FALL}	10% to 90% RF and 90% to 10% RF	ns	—	70	—
T_{ON}, T_{OFF}	50% control to 90% RF and 50% control to 10% RF	ns	—	120	—

Recommended Operating Conditions[4]

Parameter	Value
Forward Bias Current	20 mA
Reverse Bias Voltage	-10 V
Operating Temperature	-40 °C to +85 °C

Absolute Maximum Ratings[2,3,4]

Parameter	Absolute Maximum
Forward Bias Current	40 mA
Reverse Bias Voltage	-50 V
Incident Power (ON path) @ 20 mA, +85 °C, 18 GHz	33 dBm CW
Junction Temperature	+175 °C
Operating Temperature	-55 °C to +125 °C
Storage Temperature	-55 °C to +150 °C

2. Exceeding any one or combination of these limits may cause permanent damage to this device.
3. MACOM does not recommend operation at these absolute maximum ratings.
4. Operating at nominal conditions with $T_J \leq$ + 175 °C will ensure MTTF > 1 x 10^6 hours.

Handling Procedures

Please observe the following precautions to avoid damage:

Static Sensitivity

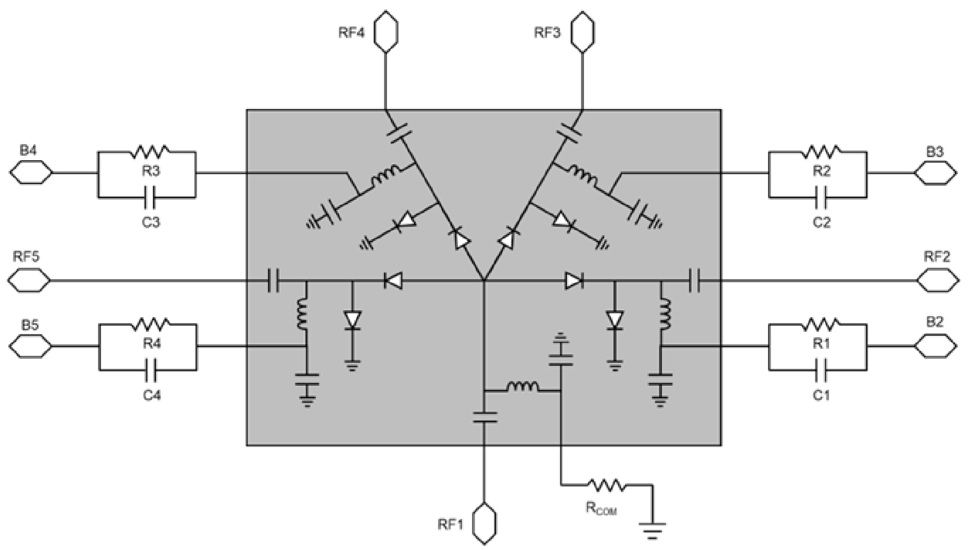
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices. The device has an ESD rating for HBM Class 1A (250 V).

Truth Table & Bias Conditions[5]

State	Bias 2	Bias 3	Bias 4	Bias 5
RF1 to RF2 ON	-15 V @ -20 mA	+5 V @ +20 mA	+5 V @ +20 mA	+5 V @ +20 mA
RF1 to RF3 ON	+5 V @ +20 mA	-15 V @ -20 mA	+5 V @ +20 mA	+5 V @ +20 mA
RF1 to RF4 ON	+5 V @ +20 mA	+5 V @ +20 mA	-15 V @ -20 mA	+5 V @ +20 mA
RF1 to RF5 ON	+5 V @ +20 mA	+5 V @ +20 mA	+5 V @ +20 mA	-15 V @ -20 mA

5. Reverse bias voltage should be determined based on working conditions. For example, -10 V @ 2 GHz, 31 dBm input power. For lower power applications, a less negative voltage can be used. See Compression Power and Junction Temperature Performance curves for guidance. Please refer to AN3022.

Application Schematic



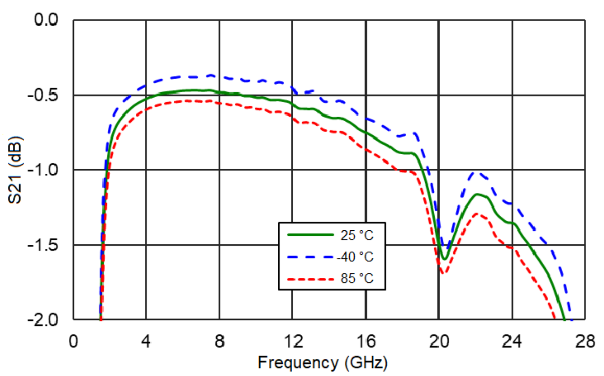
Parts List[6,7,8,9]

Part	Value
C1, C2, C3, C4	560 pF
R1, R2, R3, R4	200 Ω
R_{COM}	510 Ω

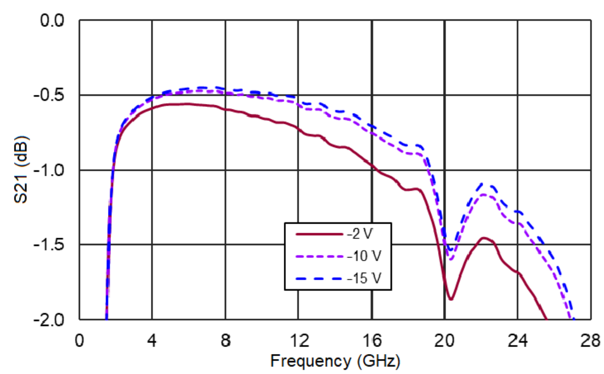
6. Assume V_F ~ 1 V at 20 mA
7. R1 = 4 V / 0.02 A = 200 Ω; R2 = 10 V/ 0.02 A = 510 Ω
8. P_{R1} = 0.02 A x 0.02 A * 200 = 0.08 W
9. P_{R2} = 0.02 A x 0.02 A * 510 = 0.2 W

Typical Performance Curves, On-Wafer: RF2 Low Loss (RF5 Identical)
V_{BIAS} = -10 V, I_{DC} = 20 mA, P_{IN} = -10 dBm (unless otherwise noted)

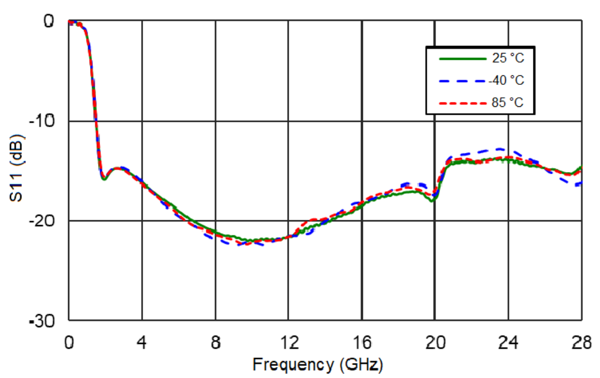
Insertion Loss over Temperature



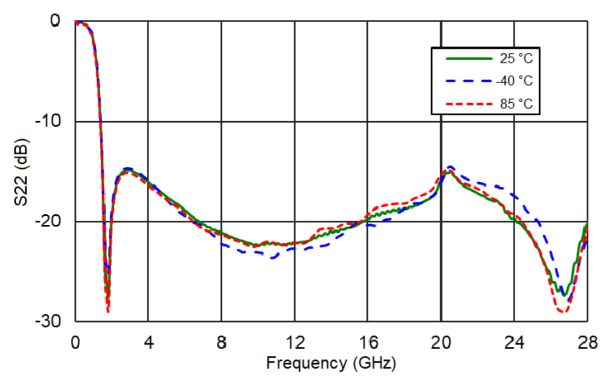
Insertion Loss over V_{BIAS} @ +25°C



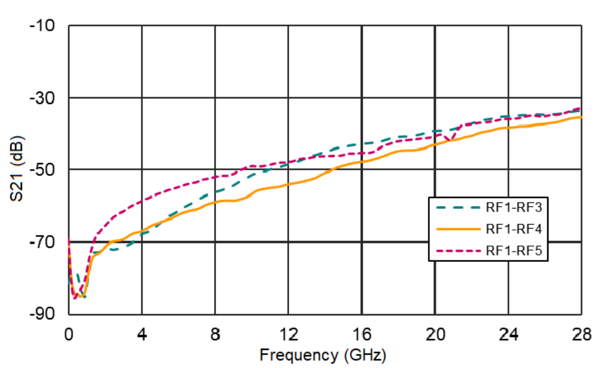
RF1 Return Loss over Temperature



RF2 Return Loss over Temperature

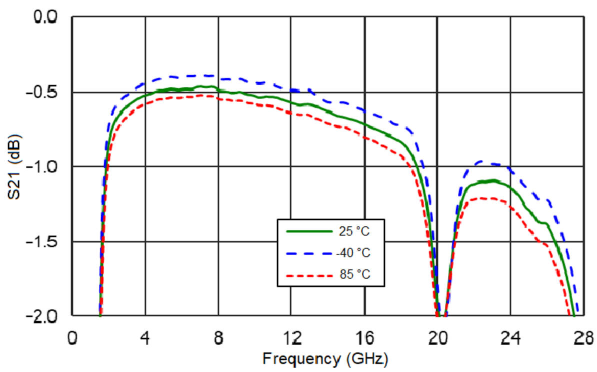


Isolation @ +25°C

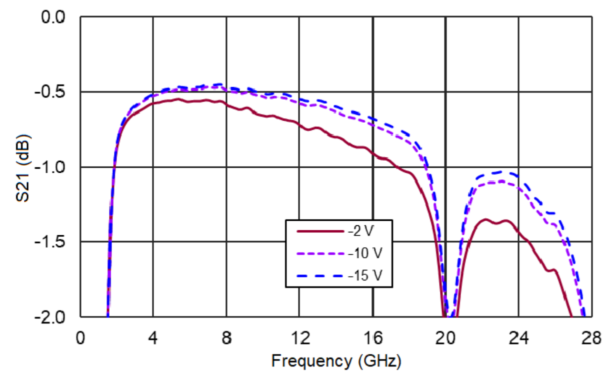


Typical Performance Curves, On-Wafer: RF3 Low Loss (RF4 Identical)
V_{BIAS} = -10 V, I_{DC} = 20 mA, P_{IN} = -10 dBm (unless otherwise noted)

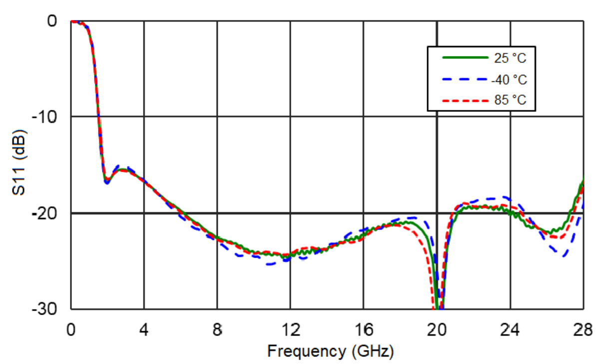
Insertion Loss over Temperature



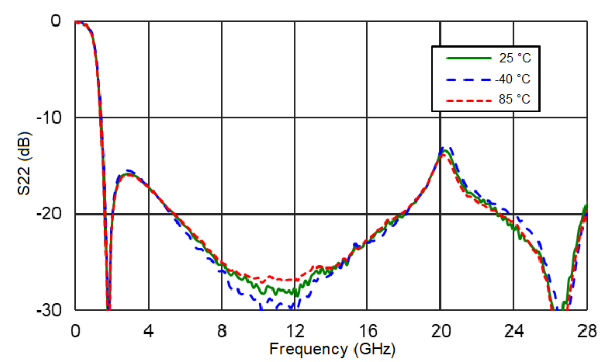
Insertion Loss over V_{BIAS} @ +25°C



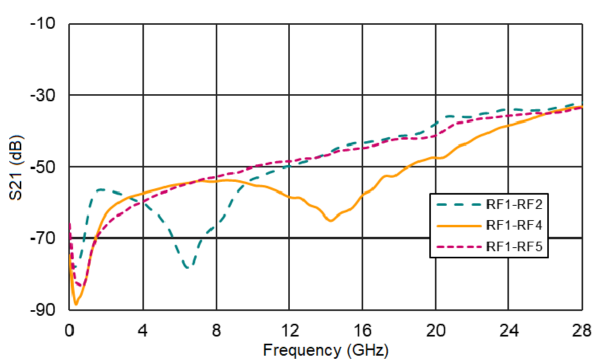
RF1 Return Loss over Temperature



RF3 Return Loss over Temperature

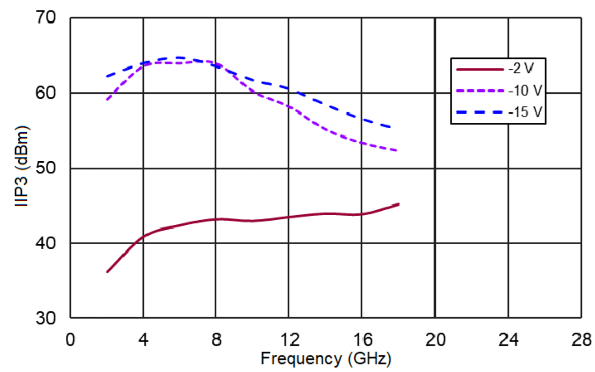


Isolation @ +25°C

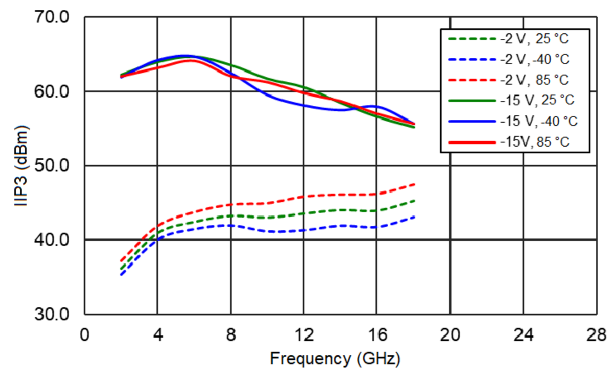


Typical Performance Curves, On-Board

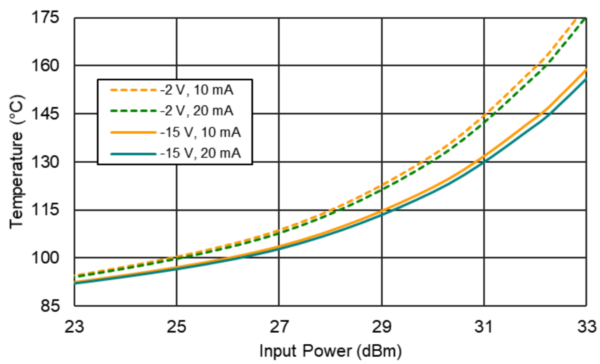
IIP3 over V_{BIAS}, @ P_{IN} = +15 dBm



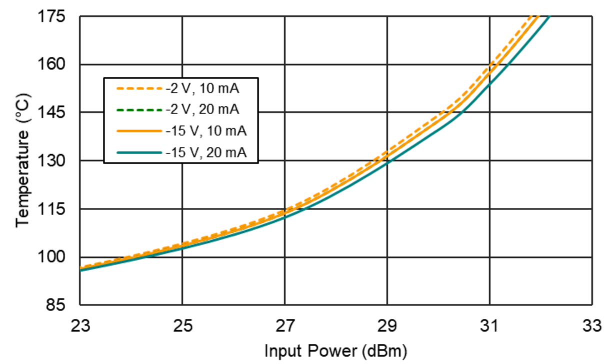
IIP3 over V_{BIAS}, Temperature @ P_{IN} = +15 dBm



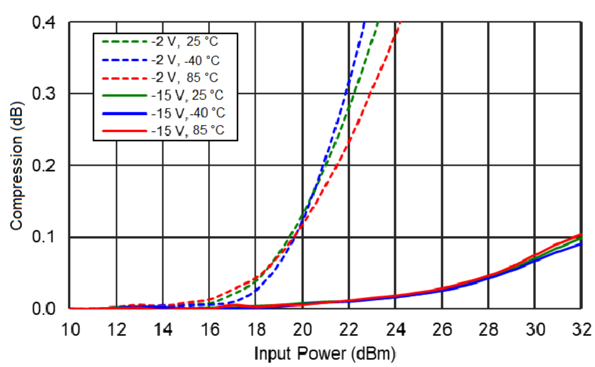
Junction Temperature over V_{BIAS}, I_{DC} @ 2 GHz, +85°C



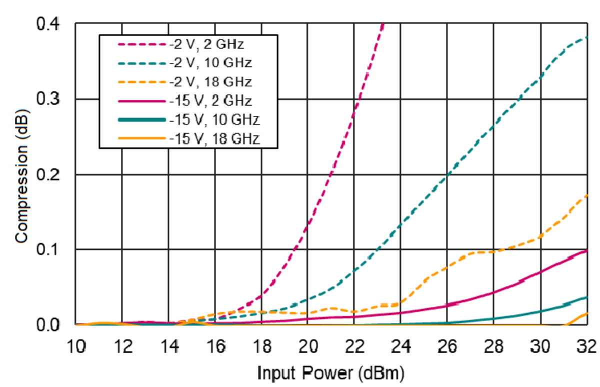
Junction Temperature over V_{BIAS}, I_{DC} @ 18 GHz, +85°C



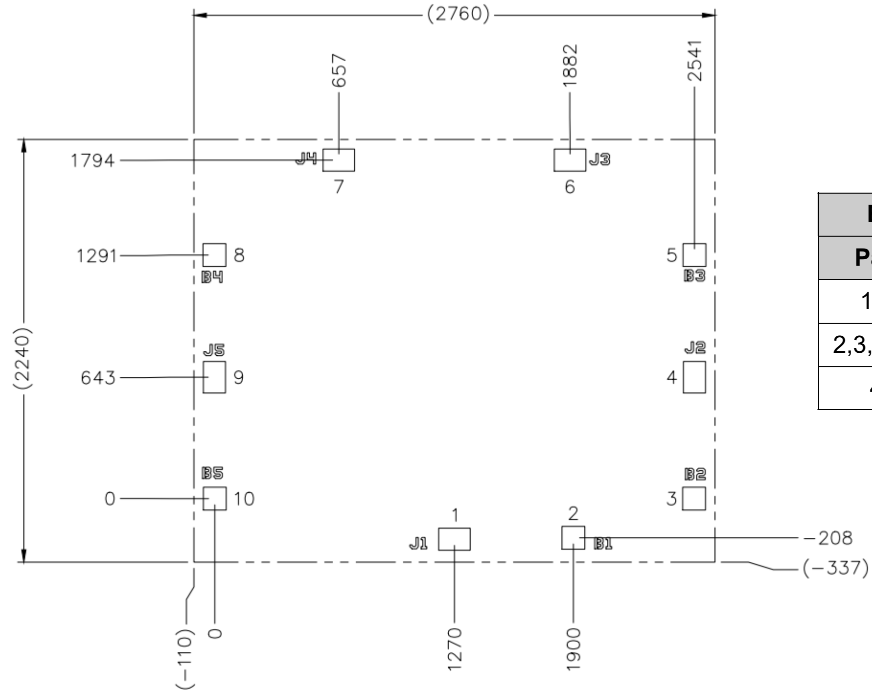
Compression Power over V_{BIAS}, Temp. @ I_{DC} = 20 mA, 2 GHz



Compression Power over V_{BIAS}, Freq. @ I_{DC} = 20 mA



Die Outline Drawing[10,11,12,13]



Bond Pad Dimensions (µm)		
Pad #	X	Y
1,6,7	167	117
2,3,5,8,10	121	121
4,9	117	167

10.Unless otherwise specified, all dimensions shown are µm with a tolerance of ±5 µm.
11.Die thickness is 125 ±10 µm.
12.Bond pad/backside metallization: gold, 2.5 µm thick.
13.Die size reflects final cut dimensions.

Wire/Ribbon and Die Attachment Recommendations

Wire Bonding:
Thermosonic wedge wire bonding using 0.00025” x 0.003” ribbon or 0.001” diameter gold wire is recommended. A heat stage temperature of 150°C and a force of 18 to 22 grams should be used. Ultrasonic energy should be adjusted to the minimum required to achieve a good bond. RF bond wires should be kept as short and straight as possible.

Mounting
The HMIC switches have Ti-Pt-Au back metal. They can be die mounted with a gold-tin eutectic solder preform or conductive epoxy. Mounting surface must be clean and flat.

Eutectic Die Attachment:
An 80/20, gold-tin, eutectic solder preform is recommended with a work surface temperature of 255°C and a tool tip temperature of 265°C. When hot gas is applied, the tool tip temperature should be 290°C. The chip should not be exposed to temperatures greater than 320°C for more than 20 seconds. No more than 3 seconds should be required for attachment. Solders containing tin should not be used.

Epoxy Die Attachment:
A minimum amount of epoxy should be used. A thin epoxy fillet should be visible around the perimeter of the chip after placement. Cure epoxy per manufacturer’s schedule (typically 125 - 150°C). For high power applications (e.g. > 27 dBm), high thermal epoxies are recommended.