MASW-011094

Ka-Band High Power Terminated SPDT PIN Switch
24 - 37 GHz

Rev. V2

Features

- Low Loss: 0.6 dB, 28 to 34 GHz
- High Isolation: >26 dB
- >40 W CW Power Handling @ +85°C
- Switching Speed: <65 ns
- Integrated DC Blocks and RF Bias Networks
- Die with G-S-G RF Pads and DC Bias Pads
- RoHS* Compliant

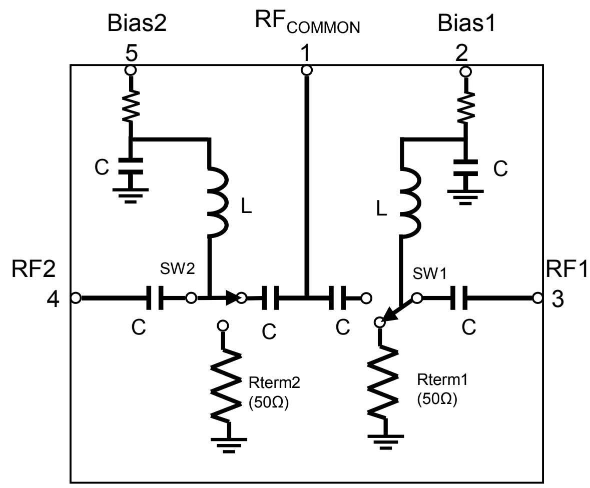
Description and Applications

The MASW-011094 is a high power SPDT with 50 Ω terminated RF ports. This broadband, high linearity, SPDT switch was developed for Ka–Band applications that require up to 40 Watts CW power handling at an environmental temperature of +85°C while maintaining low insertion loss and high isolation.

The SPDT MMIC utilizes MACOM's proven AlGaAs PIN diode technology. The switch is fully passivated with silicon nitride and has an added polymer layer for scratch protection. The protective coating prevents damage to the junction and the air-bridges during handling and assembly. The die has backside metallization to facilitate an epoxy die attach process.

These switches are ideally suited for satellite and Point-to-Point communications systems, radar systems, radiometers, test and instrumentation equipment and other high frequency applications.

Functional Schematic



Pin Configuration
(Backside metal is RF, DC, and thermal ground)

Pin No.	Function
1	RF_{COMMON}
2	Bias 1
3	RF1
4	RF2
5	Bias 2

Ordering Information[1]

Part Number	Package
MASW-011094-DIE0G	Die in Gel Pack
MASW-011094-DIERI	Die, Inked on Wafer Ring

1. Die quantity varies.

* Restrictions on Hazardous Substances, European Union Directive 2011/65/EU.

Electrical Specifications: T_A = 25°C, V_R[2] = -5 V, V_F = +7.5 V , Z_0 = 50 Ω

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss (RF_{COMMON} to RFx ON state)	26 - 28 GHz 28 - 32 GHz 32 - 36 GHz 36 - 37 GHz	dB	—	0.8 0.6 0.8 1.0	— 1.0 — —
Isolation (RF_{COMMON} to RFx OFF state)[3]	26 - 28 GHz 28 - 32 GHz 34 GHz 32 - 36 GHz 36 - 37 GHz	dB	— 25 25 — —	26 27 28 28 29	—
Return Loss (RF_{COMMON})	26 - 28 GHz 28 - 32 GHz 32 - 36 GHz 36 - 37 GHz	dB	—	14 17 12 11	—
Return Loss (RFx ON state)	26 - 28 GHz 28 - 32 GHz 32 - 36 GHz 36 - 37 GHz	dB	—	14 18 12 10	—
Return Loss (RFx OFF state)	26 - 28 GHz 28 - 32 GHz 32 - 36 GHz 36 - 37 GHz	dB	— 10 — —	10.5 15.0 11.0 9.5	—
CW Power Handling (ON state)[2]	28.5 GHz, -60 V @ +85°C	dBm	—	46	—
Switching Speed T_{RISE} / T_{FALL}	10% - 90% RF, 26.5 GHz	ns	—	16 / 34	—
Switching Speed T_{ON} / T_{OFF}	50% control to 90% RF, 26.5 GHz	ns	—	42 / 65	—
I_R - Reverse Bias Current	V_R = -60 V	nA	—	50	—
I_F - Forward Bias Current[4]	V_F = +7.5 V	mA	30	38	45

2. Reverse bias voltage should be determined based on working conditions. For example, -60 V @ 46 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 P-I-N Diode in a High Power Switch,” IEEE Transactions on Microwave Theory and Techniques, Vol.38, No.12, December 1990.
3. Isolation defined with 1 port in low loss state.
4. Forward bias voltage should be determined based on working conditions.

Absolute Maximum Ratings[5,6,7]

Parameter	Absolute Maximum
Reverse Bias Voltage	-100 V
Forward Bias Current	83 mA
Forward Bias Voltage	11 V
Incident Power (ON path)	47 dBm
Junction Temperature	+150°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-55°C to +150°C

5. Exceeding any one or combination of these limits may cause permanent damage to this device.
6. MACOM does not recommend sustained operation near these survivability limits.
7. Operating at nominal conditions with junction temperature less than 150°C will ensure MTTF >1 x 10^6 hours.

Truth Table

State	B1	B2
RF_{COMMON} to RF1 ON	-5 V	+7.5 V
RF_{COMMON} to RF2 ON	+7.5 V	-5 V

Handling Procedures

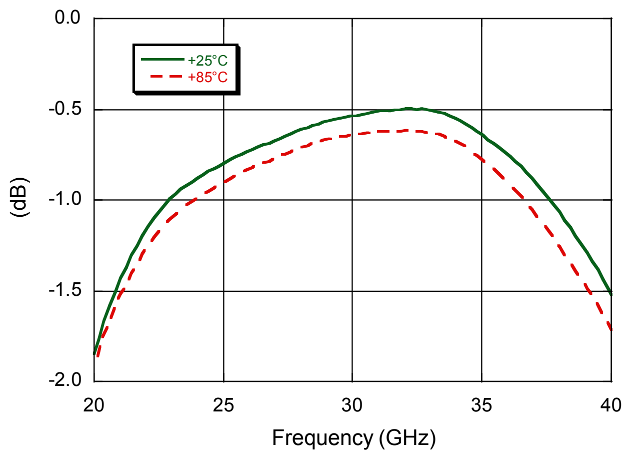
Please observe the following precautions to avoid damage:

Static Sensitivity

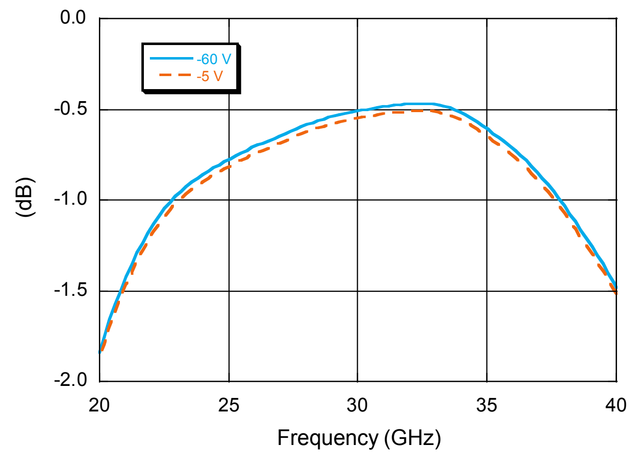
Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these HBM class 1A devices.

Typical Performance Curves

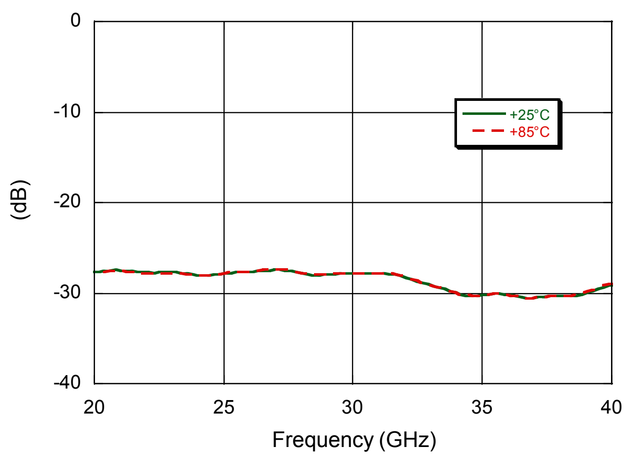
Insertion Loss



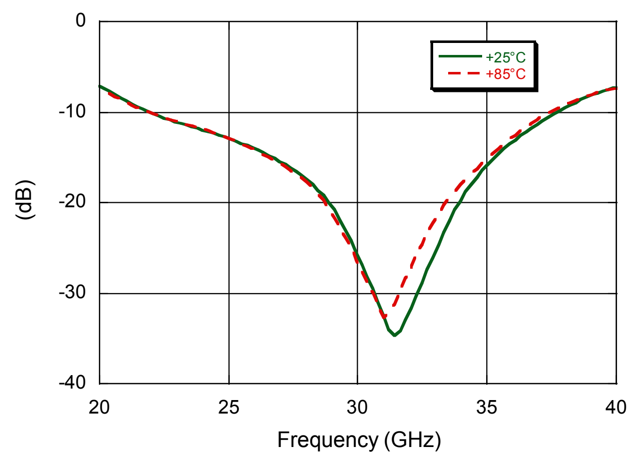
Insertion Loss over Reverse Bias Voltage



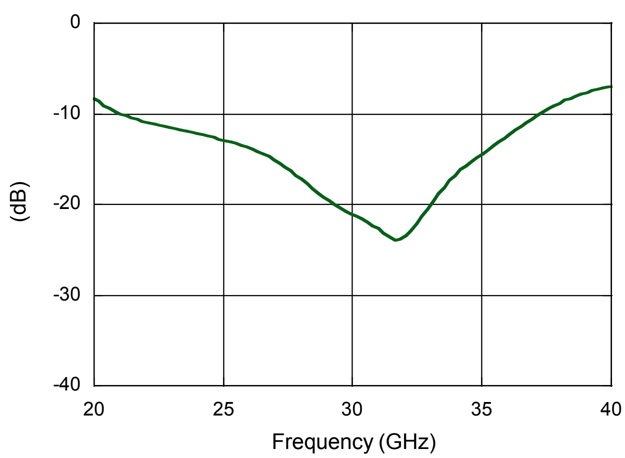
Isolation RF_{COMMON} to RFx



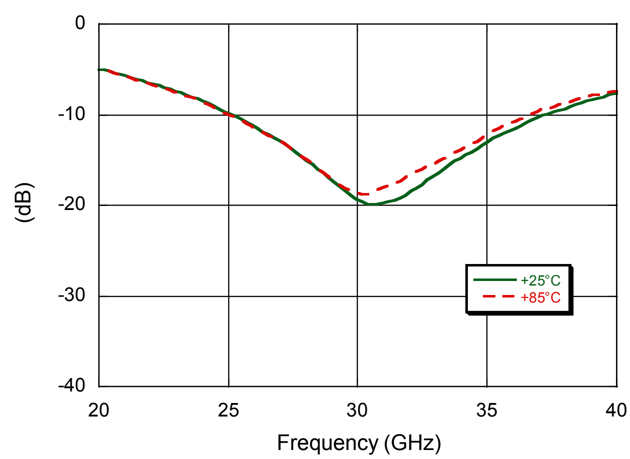
RF_{COMMON} Return Loss in ON State



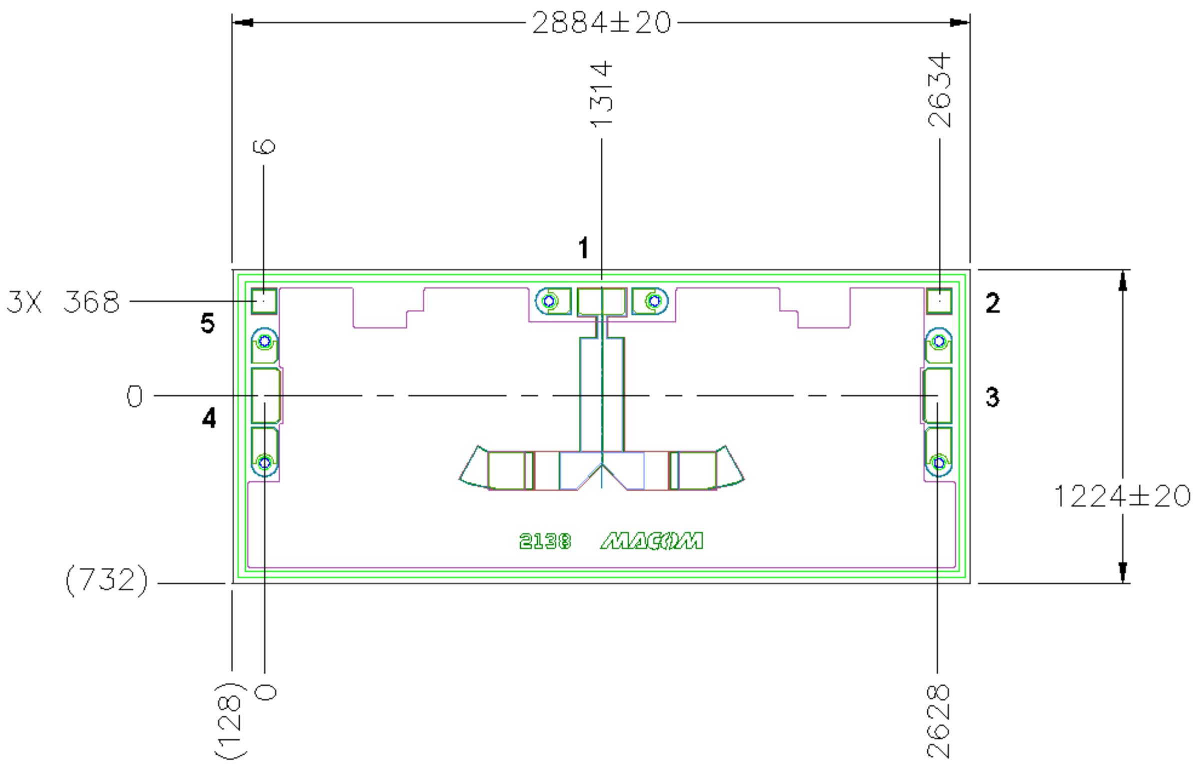
RFx Return Loss in On State



Return Loss of Terminated Port RFx



Outline Drawing



Notes:
Unless otherwise specified, All dimensions shown as µm with a tolerance of ±5 µm.
Die thickness is 100 µm ±12.5 µm.
Pad 1 = 178 x 101 µm.
Pads 2 & 5 = 88 µm sq.
Pads 3 & 4 = 101 x 208 µm.

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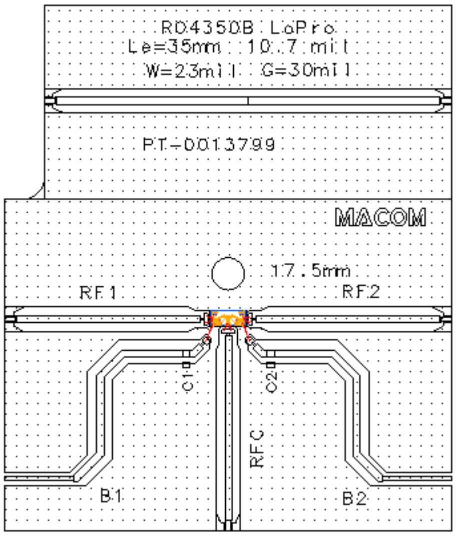
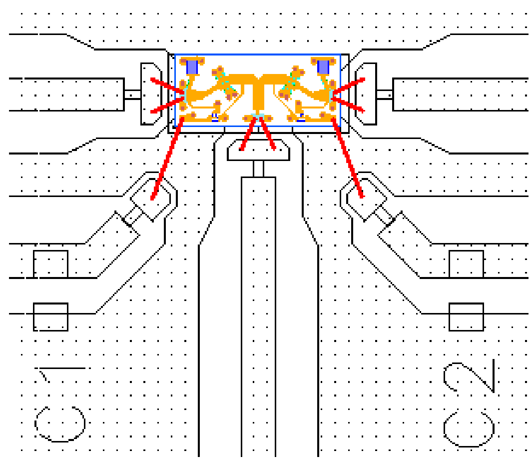
Applications Section

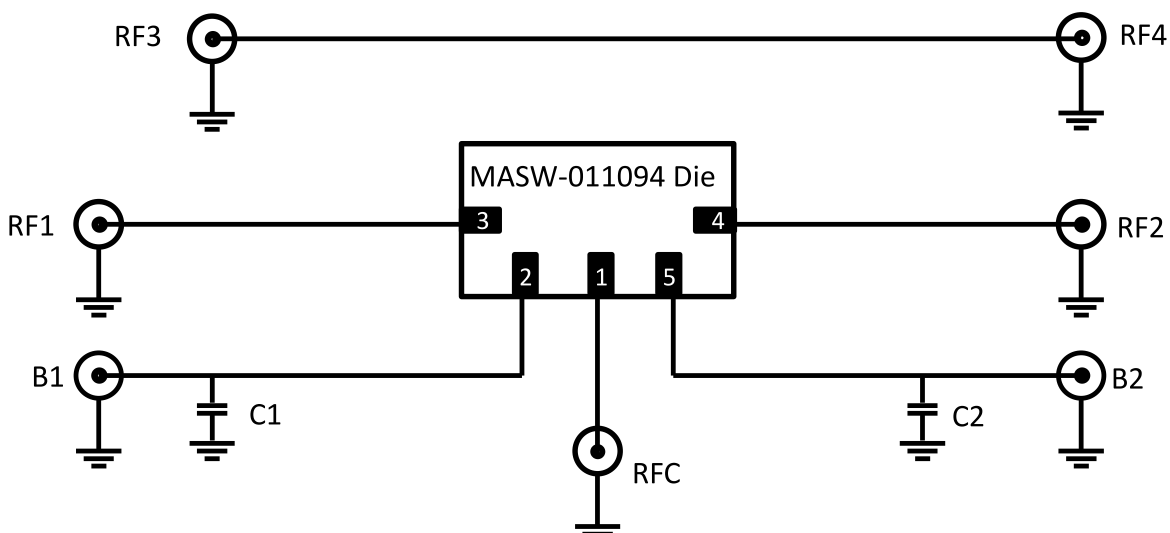
Sample Board Layout



Sample Board Layout - Detailed View



Sample Board Schematic

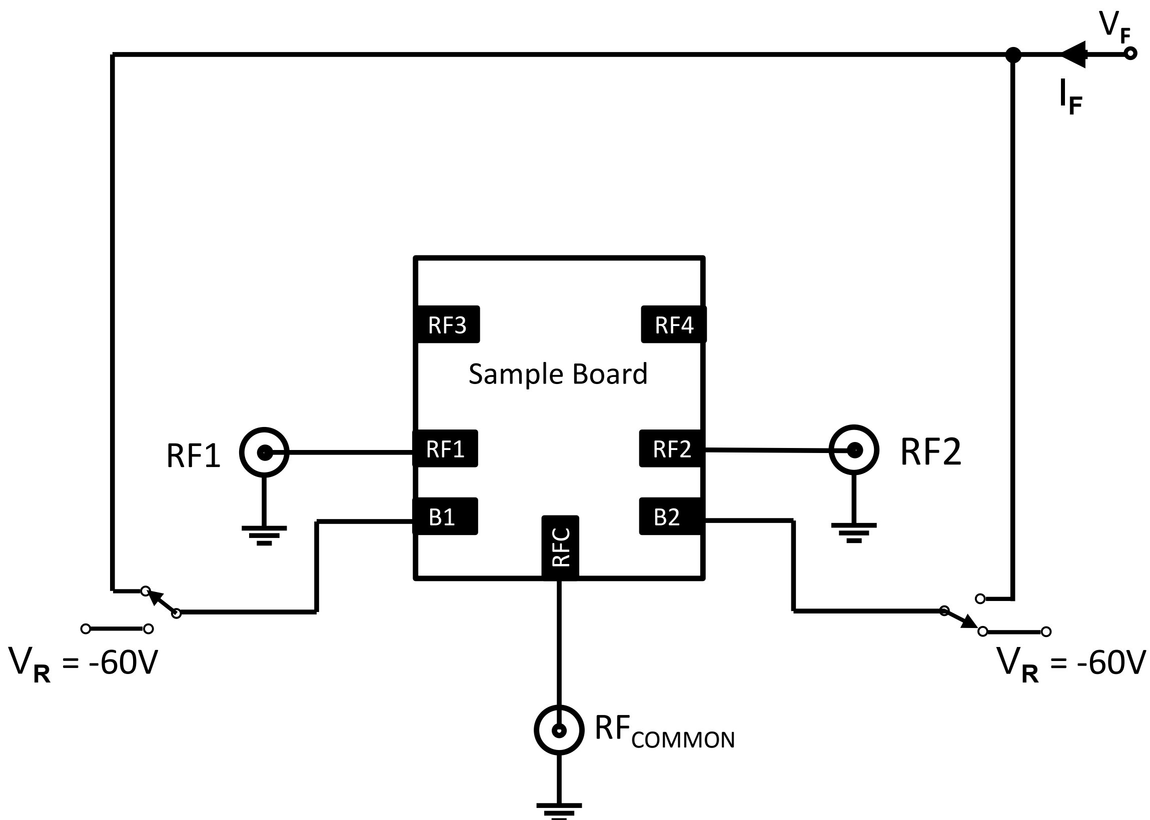


Component Designator	Description	P/N
RFC, RF1, 2, 3, and 4	2.4 mm - Southwest Microwave connector	1492-03A
B1, B2	Johnson/Emerson RF connector Or SSMA - Southwest Microwave connector	142-0761-821 292-06A
C1, C2	22 pF High Frequency Capacitor	ATC600L220

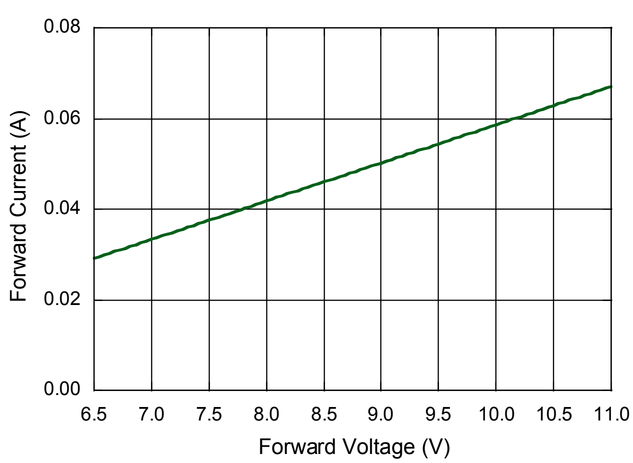
Applications Section

Sample Board Application Schematic

The schematic shown below depicts the switch in ON state of the RF_{COMMON} to RF2 and RF1 input in OFF state. The switch bias conditions are set for high power (40 W) application.



Typical Forward Current vs. Forward Voltage



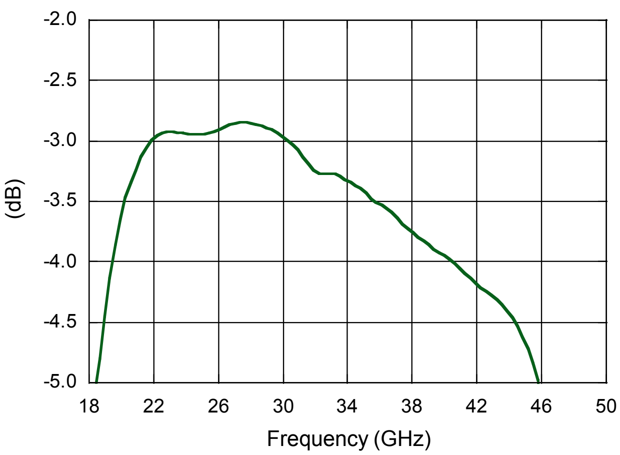
Truth Table

State	B1	B2
RF_{COMMON} to RF1 ON	-60 V	+7.5 V
RF_{COMMON} to RF2 ON	+7.5 V	-60 V

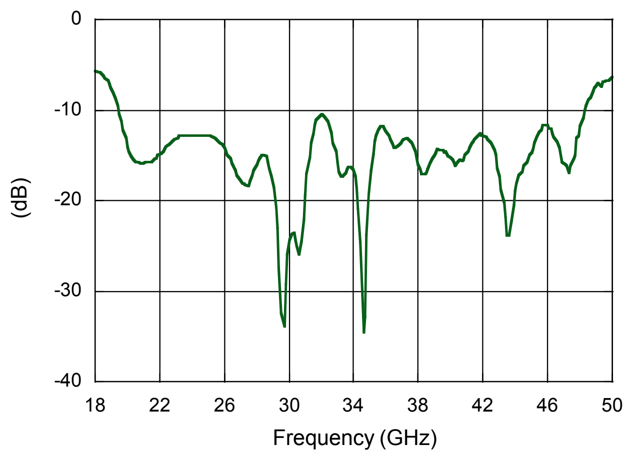
Applications Section

Typical Sample Board Performance (Not De-embedded)

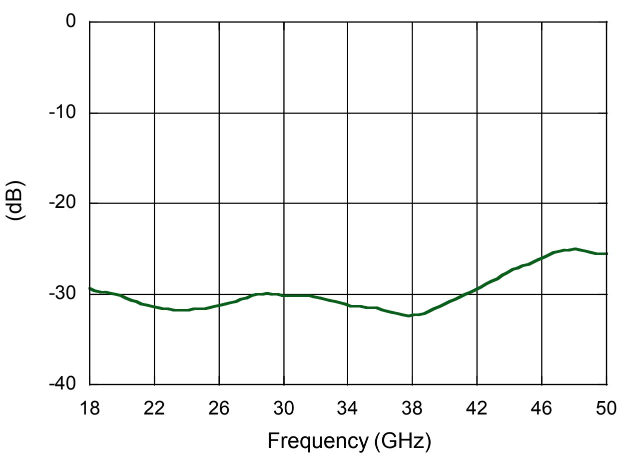
Insertion Loss



RF1 and RF2 Return Loss in On State



Isolation RF1 and RF2



RF_{COMMON} Return Loss in ON State