MPS4103-607 Datasheet

100 MHz to 3 GHz RoHS Compliant 40 Watt Monolithic SPST PIN Switch

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Power Matters.™

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Revision History

1.1 Revision 1.0

Revision 1.0 was the first publication of this document.

Contents

List of Figures

List of Tables

2 Product Overview

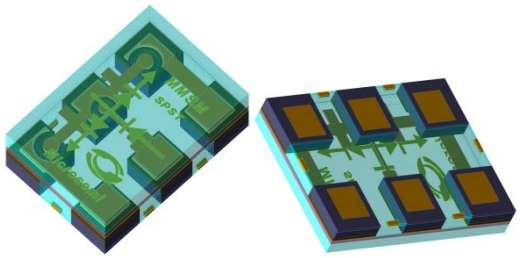
The MPS4103-607 is a RoHS compliant medium power Monolithic Microwave Surface Mount (MMSM) series-shunt pin diode SPST reflective switch. The technology is a packaged/device integration accomplished at the wafer level. Thermal transfer is optimized by elimination of the traditional package interface. The MPS4103-607 is completely compatible with pick-and-place and solder reflow manufacturing techniques.

This series of diodes meets RoHS requirements per EU Directive 2002/95/EC.

The standard terminal finish is gold unless otherwise specified. Consult the factory if you have special requirements.

The MPS4103-607 is an ESD HBM Class 1B product with a moisture sensitivity rating of MSL 2.

Figure 1 MPS4103-607



2.1 Applications

The MPS4103-607 device is optimized for UHF high power and T/R switching applications.

Up to 1 W CW power handling with as little as 5 V control.

2.1.1 Key Features

The following are the key features of the MPS4103-607.

- Series-shunt pin diode SPST
- 40 W CW power handling
- Low insertion loss
- High isolation
- Surface mount
- 0604 device size
- Stable low leakage passivation with rugged glass body
- RoHS compliant[1]
- High-power switching
- Surface-mountable
- Compact size (40 × 60 mm)

1. The MPS4103-607 devices are supplied with gold-plated terminations. For more information, contact your Microsemi representative.

3 Electrical Specifications

3.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings at 25 °C unless otherwise specified.

Table 1 Absolute Maximum Ratings

Rating	Symbol	Value	Unit
Storage temperature	T_{ST}	–65 to 150	°C
Operating temperature	T_{OP}	–65 to 125	°C
CW RF operating power	P_{CW}	40	W
Maximum dissipated power	P_{diss}	4	W
Forward DC current	I_F	200	mA
Reverse DC voltage	V_R	150	V
ESD HBM		Class 1B	
Moisture sensitivity level		MSL 2	

3.2 Typical Electrical Performance (32 V Control)

The following table shows the typical electrical performance for 32 V control.

Table 2 Typical Electrical Performance (32 V Control)

Parameter	Frequency (MHz)	Bias Condition	Minimum	Typical	Maximum
Maximum CW RF input power	ALL				40 W
Insertion loss	100	–32 V, –100 mA		0.10 dB	0.12 dB
	1500	–32 V, –100 mA		0.20 dB	0.25 dB
	3000	–32 V, –100 mA		0.50 dB	0.60 dB
Return loss	100	–32 V, –100 mA	38 dB	40 dB	
	1500	–32 V, –100 mA	18 dB	20 dB	
	3000	–32 V, –100 mA	12 dB	13 dB	
Isolation	100	–32 V, +200 mA	60 dB	70 dB	
	1500	–32 V, +200 mA	52 dB	54 dB	
	3000	–32 V, +200 mA	42 dB	44 dB	
Switching speed				500 nS	

3.3 Typical Electrical Performance (5 V Control)

The following table shows the typical electrical performance for 5 V control.

Table 3 Typical Electrical Performance (5 V Control)

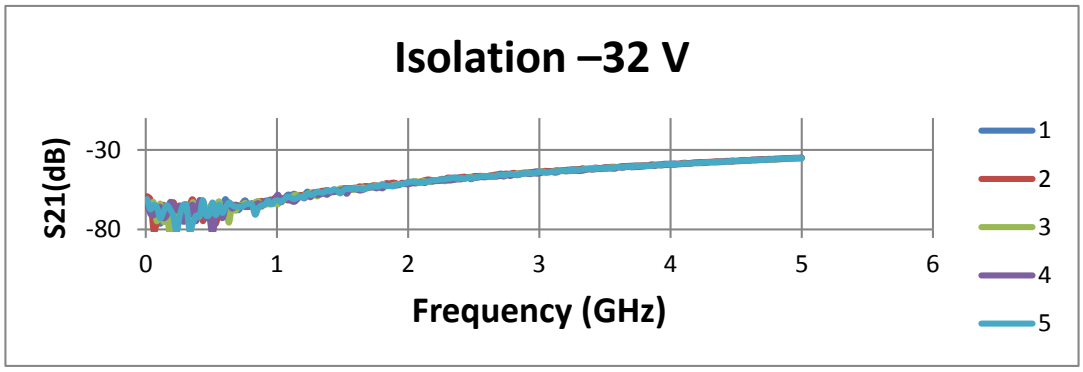
Parameter	Frequency (MHz)	Bias Condition	Minimum	Typical	Maximum
Maximum CW RF Input Power[2]	ALL				1.0 W
Insertion Loss	100	–5 V, –100 mA		0.05 dB	0.07 dB
	1500	–5 V, –100 mA		0.23 dB	0.28 dB
	3000	–5 V, –100 mA		0.50 dB	0.60 dB
Return Loss	100	–5 V, –100 mA	32 dB	34 dB	
	1500	–5 V, –100 mA	17 dB	19 dB	
	3000	–5 V, –100 mA	11 dB	13 dB	
Isolation	100	–5 V, +200 mA	60 dB	70 dB	
	1500	–5 V, +200 mA	52 dB	54 dB	
	3000	–5 V, +200 mA	42 dB	44 dB	
Switching speed				500 nS	

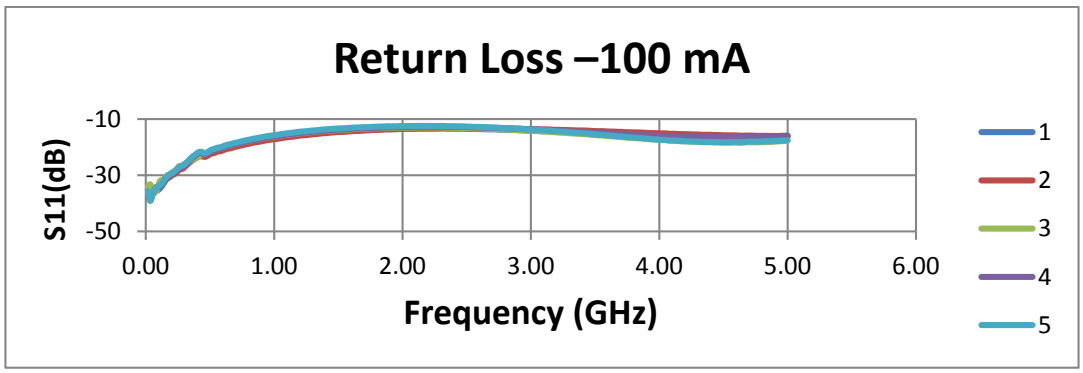
2. Maximum input power defined as <1 dB compression

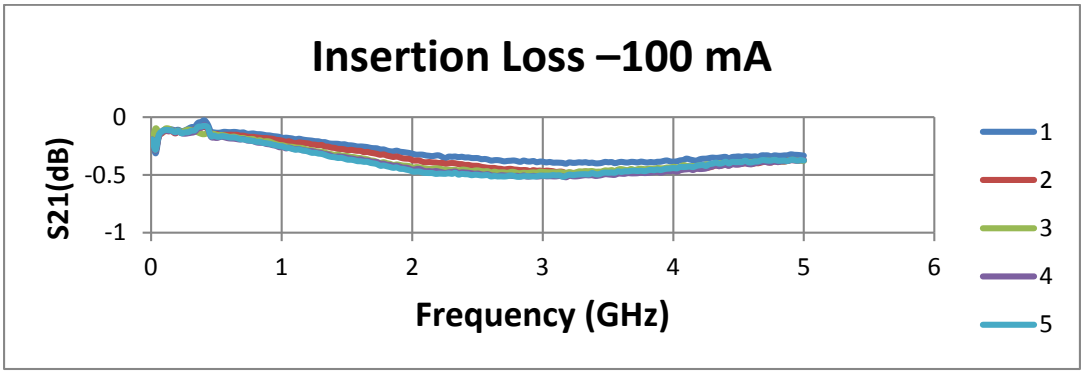
3.4 Small Signal Swept Measurements

The following illustrations show the small signal swept measurements where the bias voltage is limited by test equipment (characteristics at nominal bias equivalent or better).

Figure 2 Small Signal Swept Measurement Graphs






Insertion Loss –100 mA
S21(dB)
0
-0.5
-1
0
1
2
3
4
5
6
Frequency (GHz)
1
2
3
4
5

4 Schematic

The following illustration shows how the switching controls signals were applied.

Figure 3 Switching Controls Signals Application Schematic

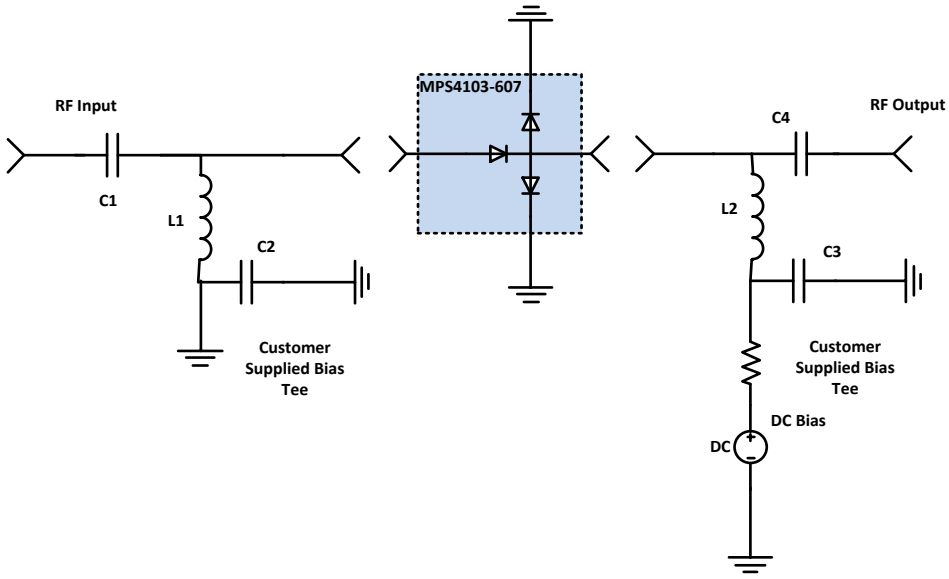


Table 4 Switching Control Signals

Band	C1, C4	C2, C3	L1, L2
VHF (100 MHz – 300 MHz)	150 pF	200 pF	400 nH
UHF (300 MHz – 3000 MHz)	40 pF	50 pF	90 nH
ISM (902 MHz – 928 MHz)	15 pF	50 pF	40 nH

5 Package Outline

The MPS4103-607 device has the following package outline specifications.

Figure 4 MPS4103-607 Package Outline

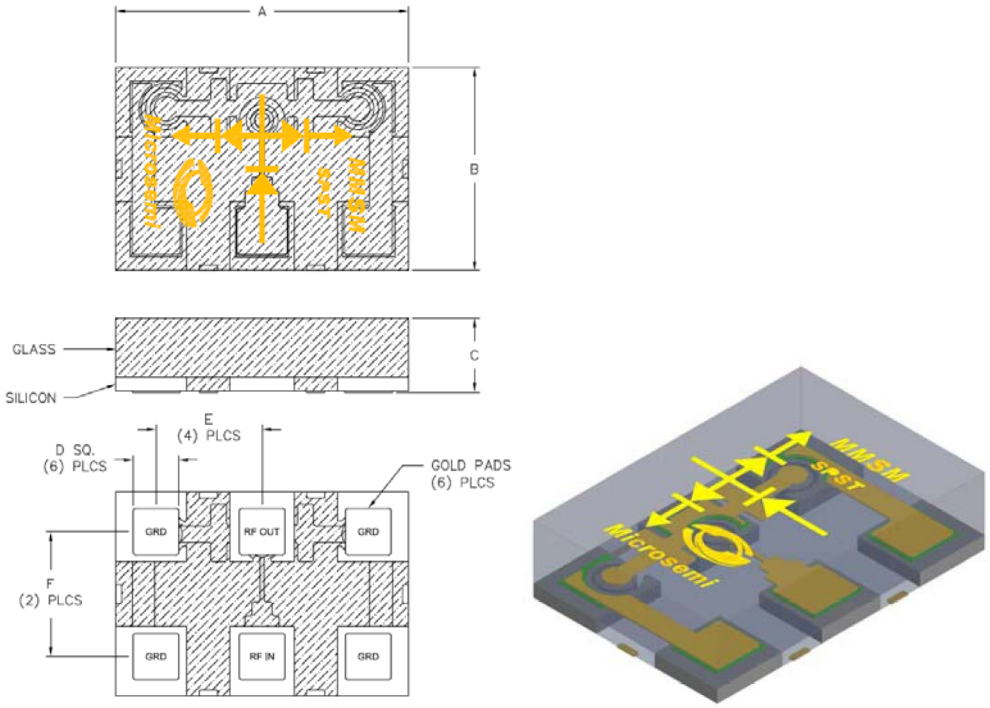


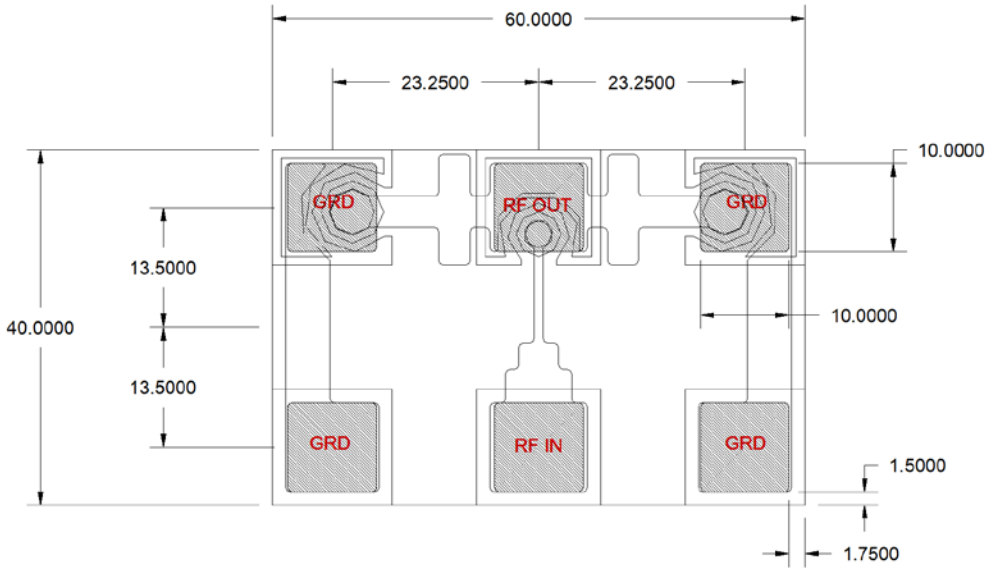
Table 5 MPS4103-607 Package Dimensions

DIM	Inches			Millimeters		
	Min	Typ	Max	Min	Typ	Max
A	0.056	0.060	0.064	1.422	1.524	1.626
B	0.036	0.040	0.044	0.914	1.016	1.118
C		0.016			0.406	
D		0.010			0.254	
E		0.023			0.584	
F		0.027			0.686	

5.1 Backside Solder Pad Dimensions

The MPS4103-607 device has the following backside solder pad dimensions.

Figure 5 Backside Solder Pad Dimensions



5.2 Installation and Handling

MMSM products are compatible with both solder and silver epoxy paste assembly processes. This includes RoHS solder. Reflow temperatures for RoHS solders such as “SAC” Sn/Ag/Cu are higher than traditional Pb/Sn solders, so extra care must be taken when employing RoHS-compatible solders. Silver epoxy paste is recommended for applications where power dissipation is minimal, such as Tuning Varactor / Schottky and low power PIN diode applications. For applications with incident power levels > 30 dBm, solder attachment is strongly recommended. Additionally, as with all microelectronic component assembly, care should be taken to insure all circuit boards are clean and free from contamination prior to any such operation.

This guide outlines the considerations for manual and automated assembly techniques utilizing either solder or silver epoxy paste.

5.2.1 Manual Handling and Installation

Solder Assembly

MMSM products are designed to be compatible with modern automatic pick and place equipment and are available in tape and reel format as well as in gel and waffle packs. Because of the nominal size of the units some care must be taken to avoid causing damage during installation. Although storage temperature ratings (non-operating) are compatible and equivalent to ratings for standard plastic encapsulated lead-frame commercial packages (i.e. –55 °C to 125 °C), temperatures during solder installation can exceed this maximum value. It is critical, therefore, as with any other microelectronic part, to minimize thermal gradients across the device. For example, during manual installation, typical electronic pencil soldering tips can exceed 375°C. When devices are first soldered down to the circuit board on one end only, followed in turn by soldering of the opposite end, the original end provides a path to thermal ground. Unlike a thermal shock test, in which both package ends are simultaneously exposed to the same temperatures, a severe thermal gradient may be created during solder iron manual installation. Specifically, if the original soldered end rests at room temperature, soldering of the second end (tip temperature = 375 °C) may create a temperature

gradient across the device of 350 °C. Use of a soldering iron tip, therefore, is strongly discouraged. If a tip must be used, the following recommendations will help minimize the risk of damage:

- Limit the tip temperature to the lowest possible temperature appropriate to exceed the liquidus point for the solder being used.
- Use the smallest tip mass available to reduce the tip thermal mass relative to the device length.
- Preheat the circuit board to 100 °C – 120 °C to further reduce the temperature gradient.

Following these recommendations will help ensure that thermal differentials are minimized to lower levels.

Silver Paste Assembly

Installation of MMSM product using silver epoxy paste is fairly straightforward. Operators familiar with silver epoxy component assembly can easily adapt their technique to handle MMSM installation. Epotek H20E or equivalent can be used for installation. It is critical that the paste is within the manufacturer's guidelines for shelf life and pot life.

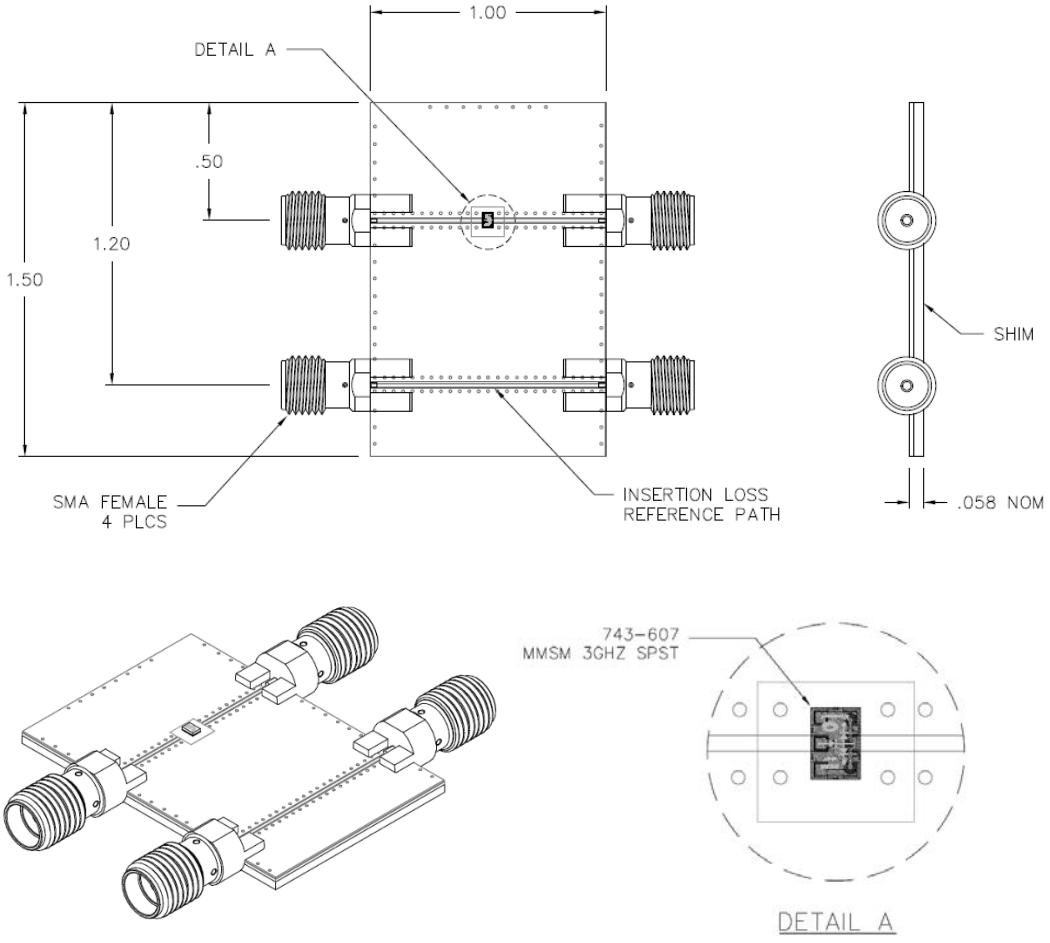
Epoxy is dispensed and placed (see solder pad outline). The dots should be approximately 10 mils in diameter. Using tweezers or a vacuum pencil, the MMSM is placed on the epoxy dots and lightly pressed into place. Excessive epoxy can cause bridging between the solder pads and short out the device. Not enough epoxy can result in poor electrical or mechanical connection. After installation of the MMSM parts, the assembly is cured using the manufacturer's recommended time and temperature settings. Improper curing can result in poor mechanical bonds and reduced electrical performance.

See MicroNote 716 at www.microsemi.com for additional installation guidance.

6 Evaluation Board Assembly

The following illustrations show the evaluation board assembly for the MPS4103-607 device.

Figure 6 Evaluation Board Assembly Diagrams



The following notes refer to the above diagrams:

- Order Microsemi part number: MSTF0010
- Material: 0.016 Rogers 4003, 0.5 oz. copper cladding on both sides (starting thickness)
- Full metal backside
- Finish: ENIG (electroless nickel immersion gold), both sides
- Solder mask topside only
- Units are in inches

7 Tape and Reel Format

The following illustrations show the tape and reel format for the MPS4103-607 device.

Figure 7 Tape and Reel Format Diagrams