GC4701-6LP

Datasheet

DC–15 GHz Surface Mount Limiter PIN Diode

Released

December 2017

Microsemi

Power Matters.™

Contents

1 Revision History

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

1.1 Revision 2.0

Revision 2.0 was published in December 2017. In Revision 2.0 of this document, the following changes were made:

- The CW Multi-Stage Transfer Characteristics (see page 7) and Pulsed Multi-Stage Transfer Characteristics (see page 9) sections were added.
- The Application Schematic and Recommended Board Layout (see page 11) section was added.

1.2 Revision 1.0

Revision 1.0 was published in September 2016. It was the first publication of this document.

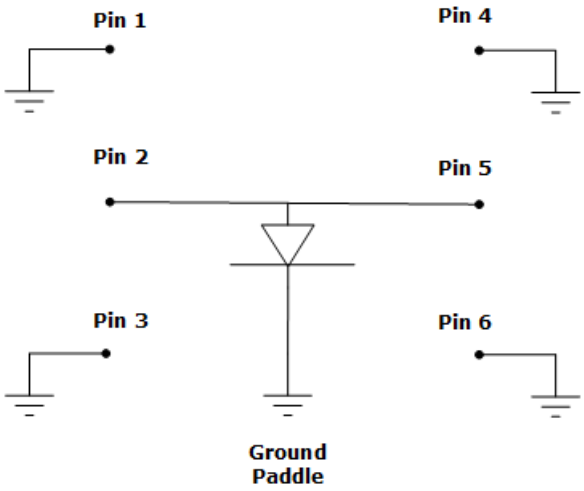
2 Product Overview

This SMT limiting diode element consists of a specially processed PIN diode packaged in a convenient, low-cost plastic outline suitable for standard or co-planar microstrip circuits. Featuring low-loss, low turn-on, and high self-biased isolation, these devices are designed for use in passive or active limiters at frequencies through X band.

This surface mount limiter meets RoHS requirements according to EU directives 2011/65/EC and 2002 /95 EC.

The following illustration shows the primary functional blocks of the GC4701-6LP device.

Figure 1 • Functional Block Diagram



2.1 Applications

A diode limiter is a power-sensitive variable attenuator that uses the non-linear properties of the diode to provide an impedance mismatch when sufficient amounts of RF power are incident on the device. The output power is reduced to a level that will not overdrive a receiver, burn out a mixer, or otherwise compromise the device. For varying input power levels in excess of the diode's threshold level, the limiter's output power tends to remain constant.

A passive limiter is one in which the limiter diodes are turned on by the RF signal itself. An active limiter is one in which the limiter diodes are turned on primarily by an external bias current typically supplied by a Schottky detector diode that senses the incident signal.

Since limiter diodes are not designed to dissipate large amounts of power, the limiter must reflect or divert the excess incident power back to the source or to another load (through a circulator or a hybrid coupler, for example).

QFN limiting diode elements may be used in microstrip, co-planar microstrip, or other media. Single or cascaded devices may be used, depending on power levels.

2.2 Benefits

The GC4701-6LP device provides the following application benefits:

- Receiver protection circuits
- Amplifier protection

2.3 Key Features

The following are key features of the GC4701-6LP device:

- Small 1.6 mm × 1.6 mm QFN
- GC4701-6LP: Output PIN diode
- Low insertion loss: 0.1 dB at 5 GHz
- Multistage designs
  - GC4212-6LP: Input PIN diode
  - GC9952-6LP: Schottky driver
- Suitable for applications to 15 GHz
- Excellent flat leakage performance
- Low-P1dB compression point: 10 dBm
- RoHS compliant

3 Electrical Specifications

This section details the electrical specifications of the GC4701-6LP device.

3.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the GC4701-6LP device.

Table 1 • Absolute Maximum Ratings

Rating	Symbol	Value	Unit
Maximum leakage current (at 80% of minimum-rated V_B)	I_R	500	nA
Operating temperature	T_{OP}	–55 to 150	°C
Storage temperature	T_{STG}	–65 to 150	°C
ESD sensitivity (HBM)		Class 1A	
Moisture sensitivity level		MSL 1	

3.2 Device Electrical Parameters

The following table shows the GC4701-6LP device electrical parameters at 25 °C where the pulse length is 1 µs.

Table 2 • Device Electrical Parameters

Parameter	Units	Condition	Min	Typ	Max
V_B	V	I_R = 10 µA	20	25	
I_R	nA	V_R = 16 V			500
CT	pF	V_R = 0 V, f = 1 MHz		0.45	
CT	pF	V_R = 10 V, f = 1 MHz		0.35	0.4
R_S	Ω	I_F = 10 mA, f = 1 GHz		1.5	2.0
T_L	ns	I_F = 10 mA, I_R = 6 mA		10	
Thermal resistance	°C/W	I heat = 0.5 A			50

3.3 Typical RF Performance

The following table shows the typical RF performance of the GC4701-6LP device at 25 °C.

Table 3 • Typical RF Performance

Parameter	Units	Condition	Min	Typ	Max
Peak power (P_{IN})	dBm	1 µs, 0.001 duty cycle			50
Leakage power (P_{OUT})	dBm	1 µs, 0.001 duty cycle		22	
Threshold	dBm	P1dB		10	
CW power (P_{IN})	dBm	Continuous			33

4 Small Signal Characteristics

The following graphs show the small signal characteristic curves of the GC4701-6LP device.

Figure 2 • GC4701-6LP Insertion Loss

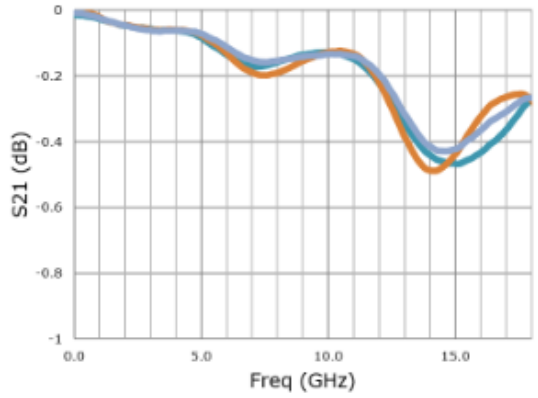


Figure 3 • GC4701-6LP Input Return Loss

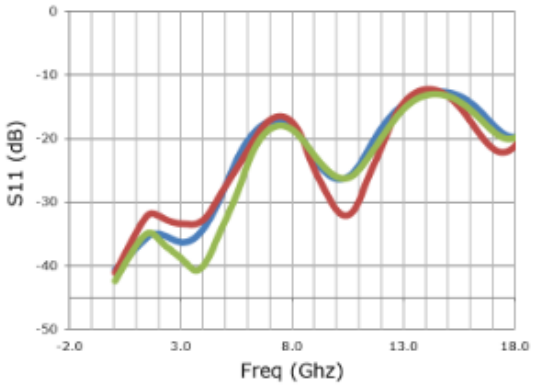


Figure 4 • GC4212-6LP/GC4701-6LP Insertion Loss

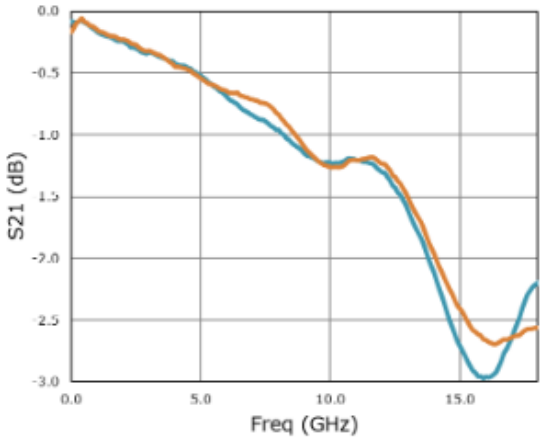


Figure 5 • GC4212-6LP/GC4701-6LP Input Return Loss

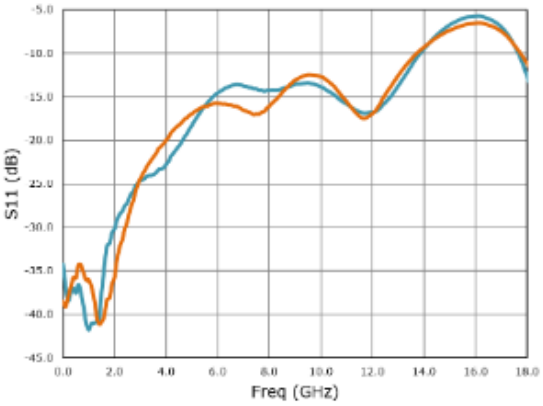


Figure 6 • GC4212-6LP/GC4701-6LP/GC9952-6LP Insertion Loss

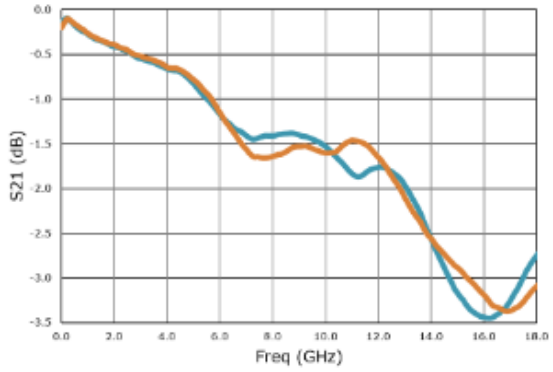
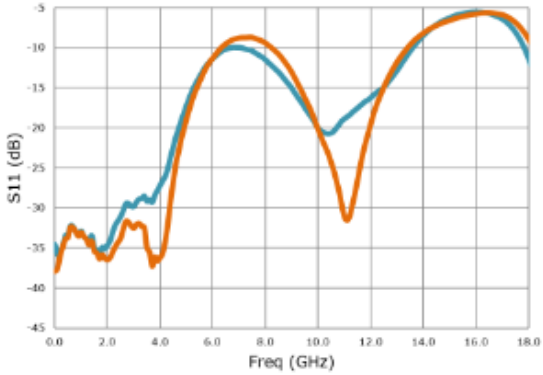


Figure 7 • GC4212-6LP/GC4701-6LP/GC9952-6LP Input Return Loss



5 Transfer Characteristics

The following graphs show the transfer characteristics of the GC4701-6LP device.

Figure 8 • CW Transfer Characteristics

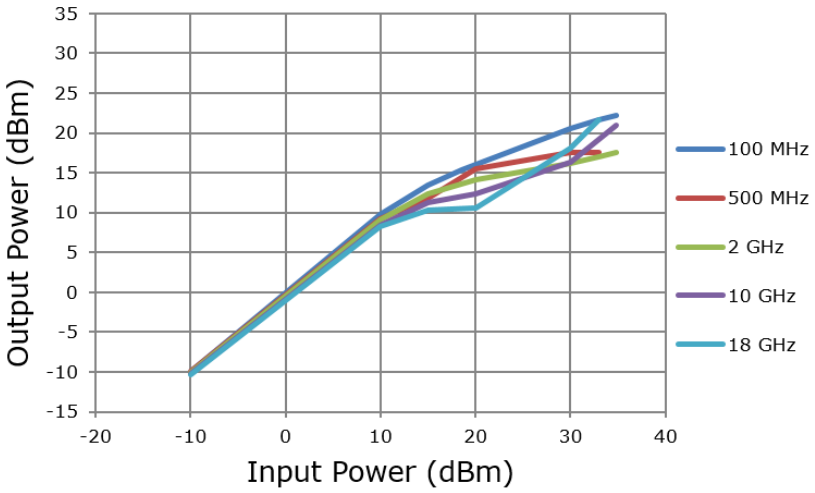
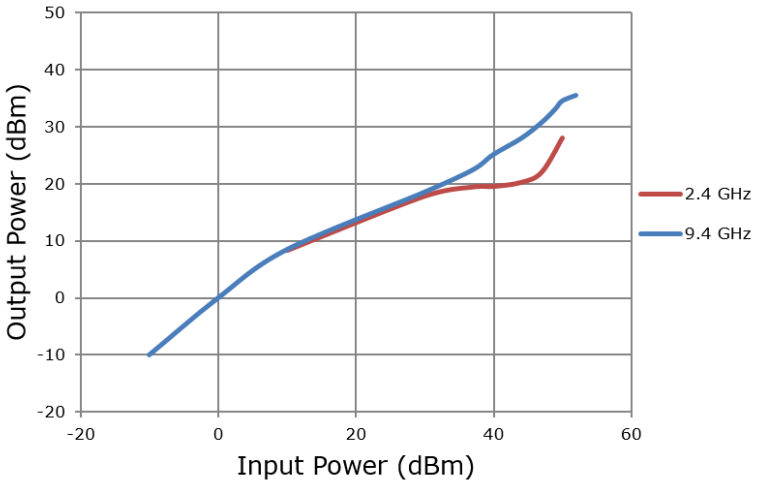


Figure 9 • Pulsed Power Transfer Characteristics

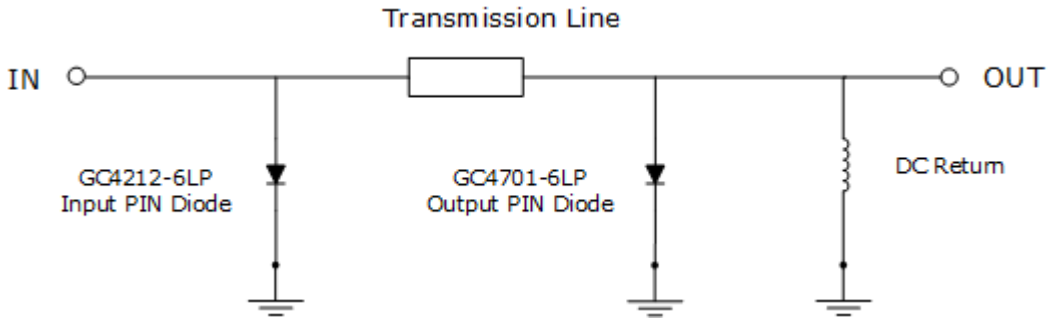


5.1 CW Multi-Stage Transfer Characteristics

This section details the CW multi-stage transfer characteristics of the GC4701-6LP device.

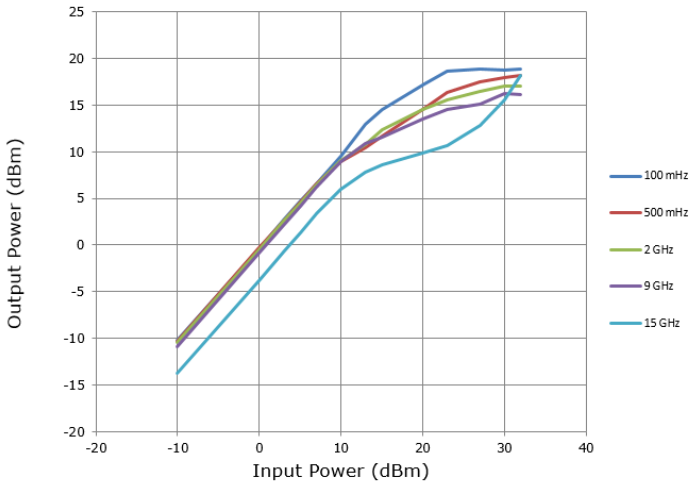
The following drawing shows the application schematic of the GC4212-6LP input PIN diode and the GC4701-6LP output PIN diode.

Figure 10 • GC4212-6LP and GC4701-6LP Application Schematic



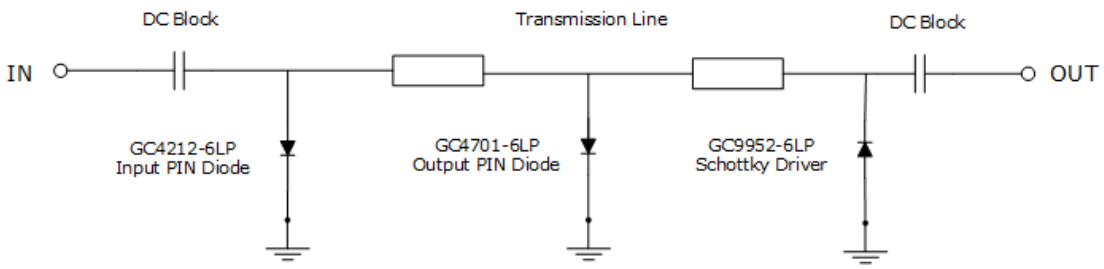
The following graph shows the CW multi-stage transfer characteristics of the GC4212-6LP input PIN diode and the GC4701-6LP output PIN diode.

Figure 11 • GC4212-6LP and GC4701-6LP CW Multi-Stage Transfer Characteristics



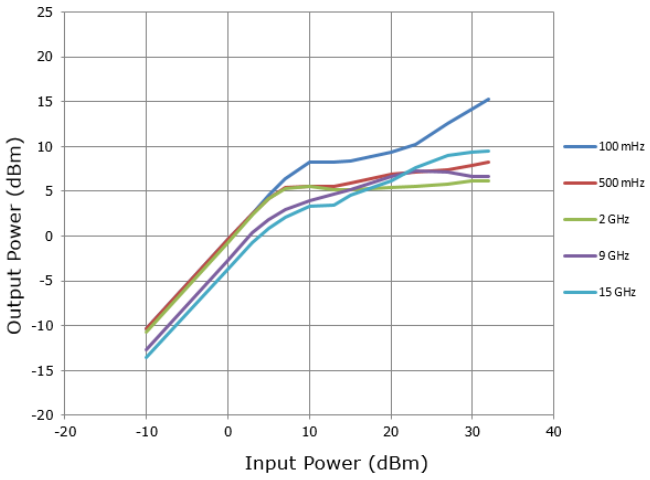
The following drawing shows the application schematic of the GC4212-6LP input PIN diode, GC4701-6LP output PIN diode, and the GC9952-6LP Schottky driver.

Figure 12 • GC4212-6LP, GC4701-6LP, and GC9952-6LP Application Schematic



The following graph shows the CW multi-stage transfer characteristics of the GC4212-6LP input PIN diode, the GC4701-6LP output PIN diode, and the GC9952-6LP Schottky driver.

Figure 13 • GC4212-6LP, GC4701-6LP, and GC9952-6LP CW Multi-Stage Transfer Characteristics

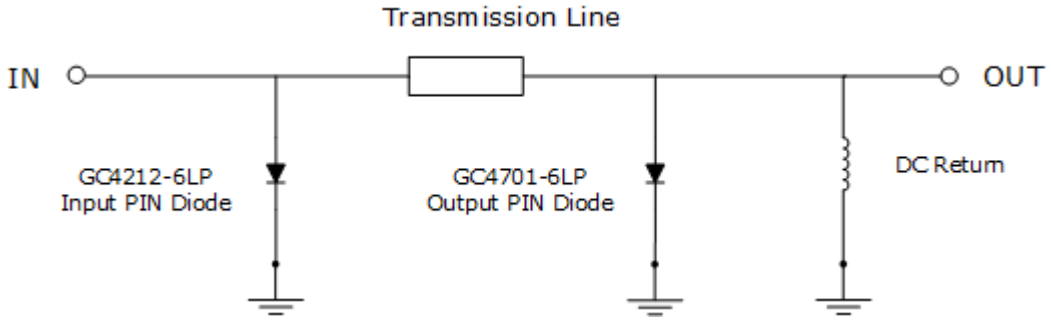


5.2 Pulsed Multi-Stage Transfer Characteristics

This section details the pulsed multi-stage transfer characteristics of the GC4701-6LP device at 1 µs, 0.001 duty cycle.

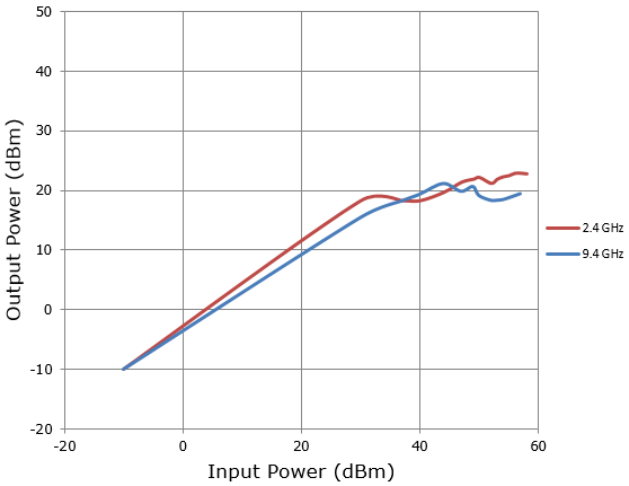
The following drawing shows the pulsed multi-stage application schematic of the GC4212-6LP input PIN diode and the GC4701-6LP output PIN diode.

Figure 14 • GC4212-6LP and GC4701-6LP Pulsed Multi-Stage Application Schematic



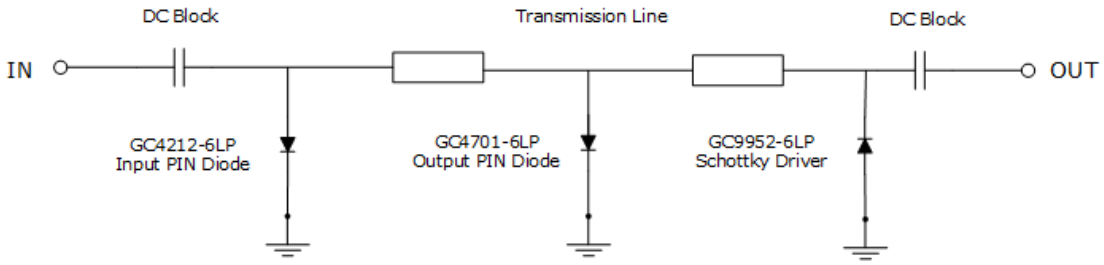
The following graph shows the pulsed multi-stage transfer characteristics of the GC4212-6LP input PIN diode and the GC4701-6LP output PIN diode.

Figure 15 • GC4212-6LP input PIN diode and GC4701-6LP Pulsed Multi-Stage Transfer Characteristics



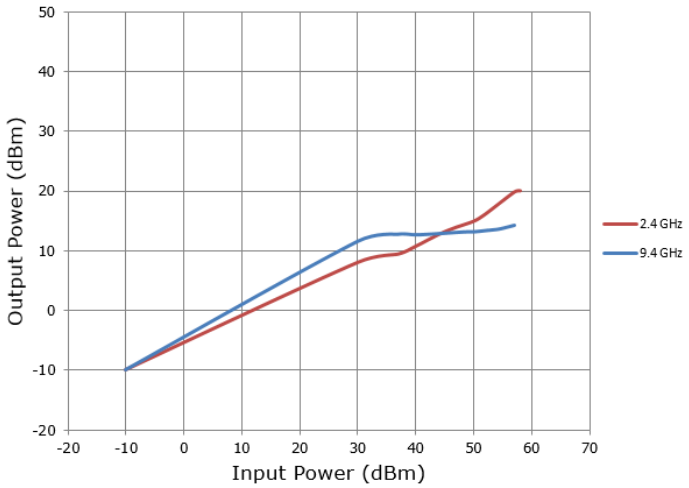
The following drawing shows the pulsed multi-stage application schematic of the GC4212-6LP input PIN diode, GC4701-6LP output PIN diode, and the GC9952-6LP Schottky driver.

Figure 16 • GC4212-6LP, GC4701-6LP, and GC9952-6LP Pulsed Multi-Stage Application Schematic



The following graph shows the pulsed multi-stage transfer characteristics of the GC4212-6LP input PIN diode, the GC4701-6LP output PIN diode, and the GC9952-6LP Schottky driver.

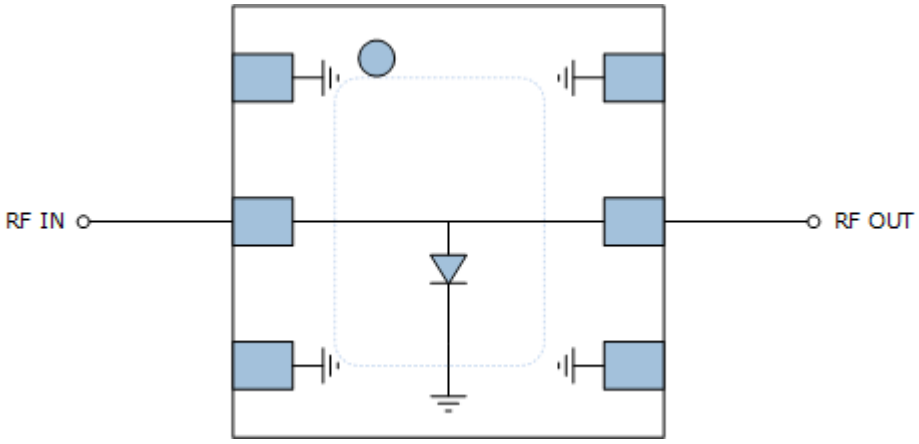
Figure 17 • GC4212-6LP, GC4701-6LP, and GC9952-6LP Pulsed Multi-Stage Transfer Characteristics



6 Application Schematic and Recommended Board Layout

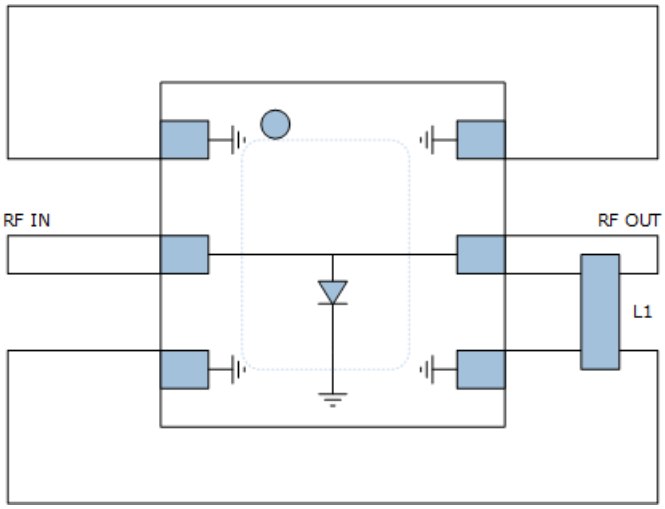
The following drawing shows the application schematic of the GC4701-6LP device.

Figure 18 • Application Schematic



The following drawing shows the recommended board layout of the GC4701-6LP device.

Figure 19 • Recommended Board Layout



The following table shows the L1 values in nH at different bandwidths.

Table 4 • L1 Values

Band Width (GHz)	L1 (nH)
1–2	40–50
2–4	20–25
4–8	10–20
8–15	8–12
1–12	40–50

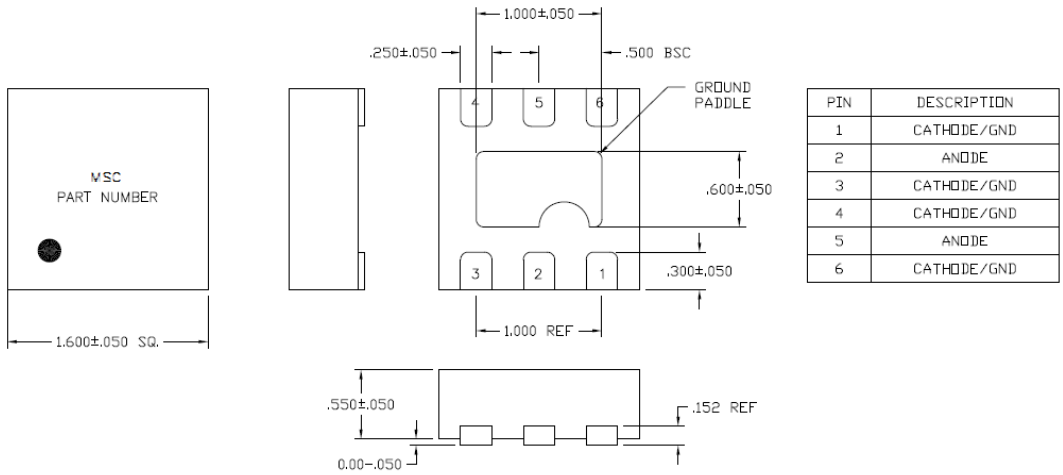
7 Package Specifications

This section details the package specifications of the GC4701-6LP device.

7.1 Package Dimensions

The following illustration shows the package outline of the GC4701-6LP device. Dimensions are in millimeters [inches].

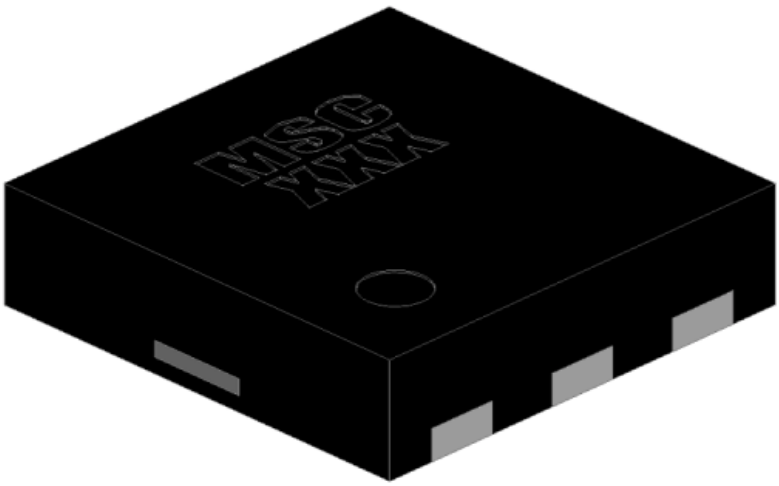
Figure 20 • Package Dimensions



7.2 Package Outline

The following illustration shows the package outline of the GC4701-6LP device. For additional packaging information, contact your Microsemi sales representative.

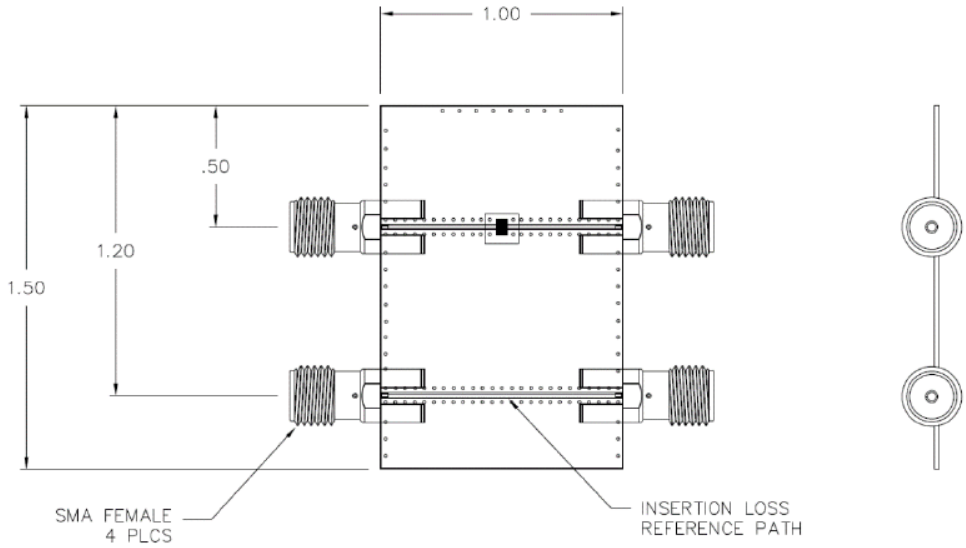
Figure 21 • Package Outline

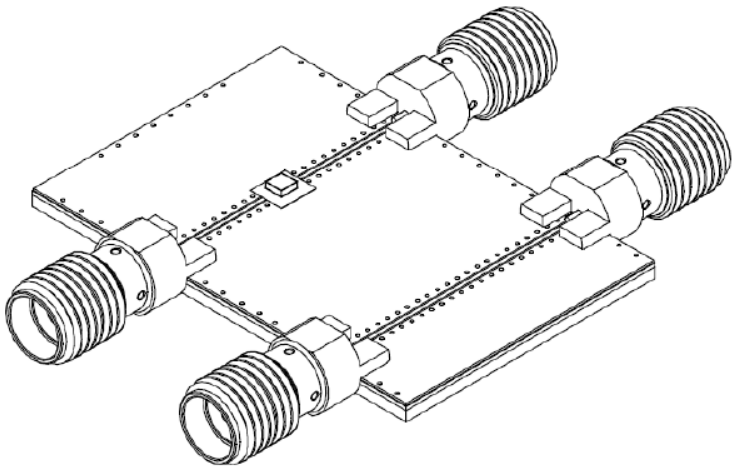


8 Evaluation Board Assembly

The following illustrations show the evaluation board assembly of the GC4701-6LP device (ordering part number: MSTF0012). The board material is 0.016 Rogers 4003, 0.5 oz. copper cladding on both sides (starting thickness). It has a full-metal backside and an electroless nickel immersion gold (ENIG) finish on both sides. Solder mask is applied to the topside only. Units are in inches.

Figure 22 • Evaluation Board Assembly

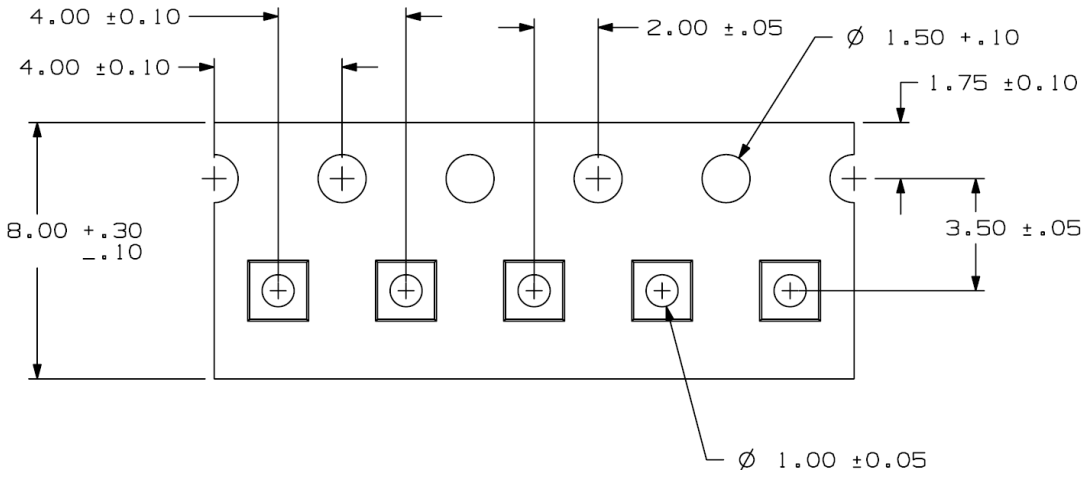




9 Tape-and-Reel Format

The following illustration shows the tape-and-reel format of the GC4701-6LP device.

Figure 23 • Tape-and-Reel Format



10 Ordering Information

The following table shows the ordering information for the GC4701-6LP device.

Table 5 • Ordering Information

Part Number	Package
GC4701	6LP 1.6 × 1.6 QFN

Microsemi Corporate Headquarters
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CA 92656 USA
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