W-SPST-90100
Previously named TU-W1401601
GaAs PHEMT MMIC Attenuator / SPST Switch, 90 – 100 GHz

Overview

The W-SPST-90100 is a GaAs PHEMT diode based SPST switch and variable attenuator with a single input and output. The attenuation value may be adjusted to any value within the specified attenuation range. The chip is manufactured on a 50um substrate with 100nm gate length. All bond pads and the die underside are gold plated. The control voltage ranges from +1.5V to -1.5V, the latter giving maximum attenuation.

This MMIC is compatible with conventional die attach methods, as well as thermocompression and thermosonic wire bonding, making it ideal for MCM and hybrid microcircuit applications. All data shown herein is provisional and is measured with the chip in a 50 Ohm environment and contacted with RF probes. A packaged version of the devices is also available with WR10 waveguide input and output.

Features

- 90 – 100GHz.
- 2 - 25 dB attenuation range.
- Low operating current.
- >15dBm power handling.
- High speed operation.
- Small chip size.

Applications

- Narrow bandwidth millimeter-wave imaging.
- Pulse modulation.
- High resolution radar.
- LNA protection.
- Sensing.
- P2P communications; short haul/high capacity/low interference links.
- Radiometry.
## Specification Overview

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>90</td>
<td>100</td>
<td>100</td>
<td>GHz</td>
<td></td>
</tr>
<tr>
<td>Insertion Loss Closed</td>
<td>1.5</td>
<td>1.75</td>
<td>2.0</td>
<td>dB</td>
<td>Biased at 1.5V, 0mA</td>
</tr>
<tr>
<td>Isolation (RF1 to RF2)</td>
<td>20</td>
<td>23</td>
<td>25</td>
<td>dB</td>
<td>Biased at -1.5V, 25mA</td>
</tr>
<tr>
<td>Return Loss Closed</td>
<td>10</td>
<td>12</td>
<td>12</td>
<td>dB</td>
<td>Biased at 1.5V, 0mA</td>
</tr>
<tr>
<td>Return Loss Open</td>
<td>6</td>
<td>12</td>
<td>12</td>
<td>dB</td>
<td>Biased at -1.5V, 25mA</td>
</tr>
<tr>
<td>Attenuation</td>
<td>2</td>
<td>25</td>
<td>25</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Maximum OP Power</td>
<td>15</td>
<td></td>
<td></td>
<td>dBm</td>
<td>at P1dB</td>
</tr>
<tr>
<td>Operating Voltage</td>
<td>-1.5</td>
<td></td>
<td>+1.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Operating Current</td>
<td>25</td>
<td></td>
<td>0</td>
<td>mA</td>
<td></td>
</tr>
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</table>

### Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Voltage</td>
<td>-2V to +10V dc</td>
</tr>
<tr>
<td>RF Power</td>
<td>25dBm</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-65°C to +150°C</td>
</tr>
<tr>
<td>Channel Temperature</td>
<td>+150°C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +85°C</td>
</tr>
</tbody>
</table>

**Notes**

The tests indicated have all been performed with 100pF de-coupling capacitors on all Vc pads. All tests are carried out at 25°C. ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features proprietary protection circuitry, damage may occur on devices subjected to ESD. Proper ESD precautions should be taken to avoid performance degradation or loss of functionality.
Measured Performance Data

Figure 1
'Closed' Return Loss

Figure 2
'Insertion Loss

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Measured Performance Data

(Vc=-1.5V, Icc=25mA)

Figure 3
'Open' Return Loss

Figure 4
Isolation

RF Frequency (GHz)

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Measured Performance Data

Figure 5
Attenuation

Figure 6
Return Loss

RF Frequency (GHz)

Attenuation (dB)

(-1.5V < Vc < 1.5V)

RF Frequency (GHz)

Return Loss (dB)

(-1.5V < Vc < 1.5V)
## Pad Descriptions

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF1</td>
<td>Input RF pad. This pad is AC coupled. (RF1 &amp; RF2 are interchangeable).</td>
</tr>
<tr>
<td>RF2</td>
<td>Output RF pad. This pad is AC coupled. (RF1 &amp; RF2 are interchangeable).</td>
</tr>
<tr>
<td>VC</td>
<td>Control Voltage pad.</td>
</tr>
<tr>
<td>BOTTOM</td>
<td>The die backside must be connected to RF/DC ground.</td>
</tr>
</tbody>
</table>

## Notes

1. All dimensions are in um.
2. Typical DC bond pads are 80um square.
3. RF bond pads are 60um square.
4. All pads have gold metallisation.
5. Gold backside metallisation.
6. Backside metal is ground.
7. Connections are not required for unlabelled bond pads.
8. Die thickness is 50um

## Die Packing Information

All die are delivered using gel-paks unless otherwise requested.
Die should be mounted on conductive material such as gold-plated metal to provide a good ground and suitable heat sink, if necessary.

1. Attaching the die using Au/Sn preforms is preferable. The Eutectic melt for Au/Sn occurs at approximately 280°C so the die (plus mount and preform) is initially heated up to 180°C and then it is heated for approximately 10 seconds to 280°C using a nitrogen heat gun. The device will survive 10 seconds at this temperature. The static breakdown for GaAs devices is approximately 330°C.
2. Pure, dry nitrogen should be used as the heat source.
3. If the devices cannot be lifted/placed by a vacuum device, then ESD die-lifting tweezers are preferable.
4. Supply lines should be decoupled with 100pF capacitors. Larger planar capacitors could be used if available.
5. Aluminium wire must not be used.
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