W-band MMIC
x4 or x8 Frequency Multiplier

W-x4x8M-8692  Previously named TU-W1340309
GaAs PHEMT MMIC x4 or x8 Multiplier, 86 - 92GHz

Overview

W-x4x8M-8692 is a frequency multiplier with integrated amplifier and filter, designed to drive the W-SBM-9296 and W-DC-9296 mixers so that frequencies in the 92-96 GHz range can be easily realized using a 5.4 GHz baseband signal. This MMIC has a wideband input impedance match which means that it can operate in both x4 or x8 modes, with inputs of ~22 or ~11 GHz respectively. The circuit is designed on a 50um GaAs PHEMT substrate.

All bond pads and the die backside are gold plated and compatible with conventional die attach methods, as well as thermo-compression 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.

Features

- Either x4 or x8 operation
- 86-92 GHz output. (x4 mode)
- 86.6-90.6 GHz output. (x8 mode)
- >8dB return loss.
- Up to 8dBm output power.

Applications

- Narrow bandwidth millimeter-wave imaging.
- High resolution radar.
- Sensing.
- P2P communications; short haul/high capacity/low interference links.
GaAs PHEMT MMIC x4 or x8 Multiplier, 86 - 92GHz

Product datasheet

www.arralis.com

Specification Overview - x4 Mode

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Frequency</td>
<td>21.5</td>
<td></td>
<td>23</td>
<td>GHz</td>
</tr>
<tr>
<td>Output Frequency</td>
<td>86</td>
<td></td>
<td>92</td>
<td>GHz</td>
</tr>
<tr>
<td>Gain</td>
<td></td>
<td>-7</td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Multiplication Factor</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Power</td>
<td>0</td>
<td></td>
<td>8</td>
<td>dBm</td>
</tr>
<tr>
<td>5th Harmonic Attenuation</td>
<td>27</td>
<td></td>
<td></td>
<td>dB</td>
</tr>
<tr>
<td>Current</td>
<td>210</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>

Notes:
The tests indicated have all been performed with 100pF de-coupling capacitors on all bias pads. All tests are carried out at 25°C.

Drain Bias on 1st Stage = 0.7V, Gate Bias on 1st Stage = -1.1V; Drain Bias on other stages = 2V; Gate Bias on other stages = 0V

Specification Overview - x8 Mode

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Frequency</td>
<td>10.825</td>
</tr>
<tr>
<td>Output Frequency</td>
<td>86.6</td>
</tr>
<tr>
<td>Gain</td>
<td></td>
</tr>
<tr>
<td>Multiplication Factor</td>
<td>8</td>
</tr>
<tr>
<td>Output Power</td>
<td>-2</td>
</tr>
<tr>
<td>7th Harmonic Attenuation</td>
<td>18</td>
</tr>
<tr>
<td>9th Harmonic Attenuation</td>
<td>28</td>
</tr>
<tr>
<td>Current</td>
<td>210</td>
</tr>
</tbody>
</table>

Notes:
The tests indicated have all been performed with 100pF de-coupling capacitors on all bias pads. All tests are carried out at 25°C.

Gate Bias on 1st Stage = -0.6V, Gate Bias on other stages = 0V; Drain Bias on all stages = 4V
Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gate Voltage</td>
<td>-5V to 0.2V dc</td>
</tr>
<tr>
<td>Drain Voltage</td>
<td>5V</td>
</tr>
<tr>
<td>Drain Current</td>
<td>600mA</td>
</tr>
<tr>
<td>RF Input 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>
Measured Performance Data

**x4 Operation**

Figure 1

(VD1=0.7V, VG1=-1.1V, VDx=2V, VGx=0V, IDD=210mA)

Output Frequency (GHz)

Figure 2

(VD1=0.7V, VG1=-1.1V, VDx=2V, VGx=0V, IDD=210mA)

Gain (dB)

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Measured Performance Data

x4 Operation

Figure 3
(x4 Mode)
5th Harmonic Attenuation from 4th Order

(VD1=0.7V, VG1=-1.1V, VDx=2V, VGx=0V, IDD=210mA)
Measured Performance Data

x8 Operation

Figure 4
(x8 Mode) Output Power

(VG1=-0.6V, VDD=4V, VGx=0V, IDD=210mA)

Figure 5
(x8 Mode) Conversion Gain

(VG1=-0.6V, VDD=4V, VGx=0V, IDD=210mA)
Measured Performance Data

x8 Operation

Figure 6
7th Harmonic Attn. from 8th

(VG1=-0.6V, VDD=4V, VGx=0V, IDD=210mA)

Output Frequency (GHz)

9dBm IP Power
12dBm IP Power
14dBm IP Power

Attenuation (dB)

Figure 7
9th Harmonic Attn. from 8th

(VG1=-0.6V, VDD=4V, VGx=0V, IDD=210mA)

Output Frequency (GHz)

9dBm IP Power
12dBm IP Power
14dBm IP Power

Attenuation (dB)
Pad Descriptions

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RFIN</td>
<td>Input RF pad. This pad is AC coupled.</td>
</tr>
<tr>
<td>RFOUT</td>
<td>Output RF pad. This pad is AC coupled.</td>
</tr>
<tr>
<td>VDx</td>
<td>Drain bias pad for stage x</td>
</tr>
<tr>
<td>VGx</td>
<td>Gate bias pad for stage x.</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 &mu;m.
2. Typical DC bond pads are 80&mu;m square.
3. RF bond pads are 60&mu;m square.
4. All pads have gold metalisation.
5. Gold backside metalisation.
6. Backside metal is ground.
7. Connections are not required for unlabelled bond pads.
8. Die thickness is 50&mu;m

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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