**GaAs MMIC Millimeter Wave Doubler** **MMD-2050HSM**

# 1. Device Overview




QFN

## 1.1 General Description

The MMD-2050HSM is a passive MMIC millimeter wave doubler fabricated with GaAs Schottky diodes. This operates over a guaranteed 10 to 25 GHz input frequency range or a doubled output frequency range of 20 to 50 GHz. It features excellent conversion loss, superior isolations, and high harmonic suppressions across a broad bandwidth. Both surface mount QFN and evaluation boards are available.

## 1.2 Features

- High fundamental rejection
- Millimeter wave output frequencies
- RoHS Compliant
- +10dBm to +15dBm LO drive

## 1.3 Applications

- High frequency synthesis
- LO signal chain

## 1.4 Functional Block Diagram




## 1.5 Part Ordering Options[1]

| Part Number | Description | Package | Green Status | Product Lifecycle | Export Classification |
|---|---|---|---|---|---|
| **MMD-2050HSM** | 3mm QFN Surface Mount | SM | **RoHS** | Active | EAR99 |
| **EVAL-MMD-2050H** | Connectorized Evaluation Fixture | Eval | | Active | EAR99 |

[1] Refer to our website for a list of definitions for terminology presented in this table.

Copyright © 2020 Marki Microwave, Inc.

## Table of Contents

1. Device Overview ..... 1
1.1 General Description ..... 1
1.2 Features ..... 1
1.3 Applications ..... 1
1.4 Functional Block Diagram ..... 1
1.5 Part Ordering Options ..... 1
2. Port Configurations and Functions ..... 3
2.1 Port Diagram ..... 3
2.2 Port Functions ..... 3
3. Specifications ..... 4
3.1 Absolute Maximum Ratings ..... 4
3.2 Package Information ..... 4
3.3 Recommended Operating Conditions ..... 4
3.4 Sequencing Requirements ..... 4
3.5 Electrical Specifications ..... 5
3.6 Typical Performance Plots ..... 6
4. Mechanical Data ..... 8
4.1 SM Package Outline Drawing ..... 8
4.2 SM Package Footprint ..... 8
4.3 EVAL Package Outline Drawing ..... 9

**Revision History**

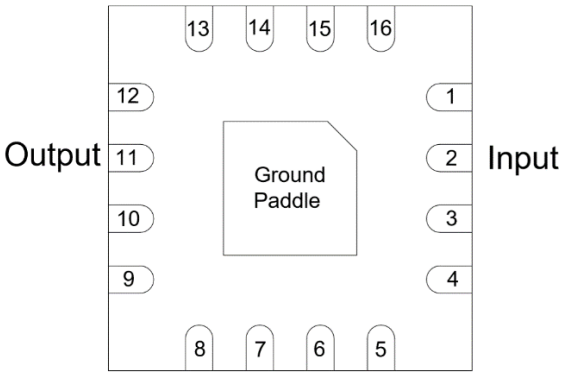
| Revision Code | Revision Date | Comment |
|---|---|---|
| - | February 2020 | Initial Release |

Copyright © 2020 Marki Microwave, Inc.

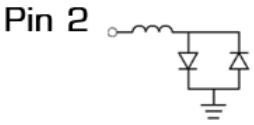
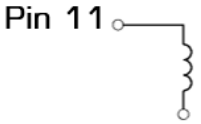
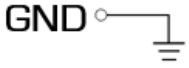
# 2. Port Configurations and Functions

## 2.1 Port Diagram

A bottom-up view of the MMD-2050HSM outline drawing is shown below. The MMD-2050H should only be used in the forward direction, with the input and output ports given in Port Functions.




## 2.2 Port Functions

| Port | Function | Description | Equivalent Circuit for Package |
|---|---|---|---|
| Pin 2 | 1F Input | Pin 2 is diode coupled and AC matched to 50 Ohms from 10-25GHz |   |
| Pin 11 | 2F Output | Pin 11 is DC open and AC matched to 50 Ohms from 20-50GHz |   |
| GND | Ground | SM package ground path is provided through the ground paddle. |   |

Copyright © 2020 Marki Microwave, Inc.

# 3. Specifications

## 3.1 Absolute Maximum Ratings

The Absolute Maximum Ratings indicate limits beyond which damage may occur to the device. If these limits are exceeded, the device may be inoperable or have a reduced lifetime.

| Parameter | Maximum Rating | Units |
|---|---|---|
| Power Handling, at any Port | TBD | dBm |
| Operating Temperature | -55 to +100 | °C |
| Storage Temperature | -65 to +125 | °C |

## 3.2 Package Information

| Parameter | Details | Rating |
|---|---|---|
| ESD | Human Body Model (HBM), per MIL-STD-750, Method 1020 | 1A |
| Weight | EVAL Package | TBD |

## 3.3 Recommended Operating Conditions

The Recommended Operating Conditions indicate the limits, inside which the device should be operated, to guarantee the performance given in Electrical Specifications Operating outside these limits may not necessarily cause damage to the device, but the performance may degrade outside the limits of the electrical specifications. For limits, above which damage may occur, see Absolute Maximum Ratings.

| | Min | Nominal | Max | Units |
|---|---|---|---|---|
| $T_A$, Ambient Temperature | -55 | +25 | +100 | °C |
| Input Power | +10 | | +15 | dBm |

## 3.4 Sequencing Requirements

There is no requirement to apply power to the ports in a specific order. However, it is recommended to provide a 50Ω termination to each port before applying power. This is a passive diode doubler that requires no DC bias.

Copyright © 2020 Marki Microwave, Inc.

## 3.5 Electrical Specifications

The electrical specifications apply at $T_A$=+25°C in a 50Ω system. Typical data shown is for the EVAL package doubler used in the forward direction with a +11 dBm sine wave input.

Min and Max limits apply only to our EVAL units and are guaranteed at $T_A$=+25°C.

| Parameter | Test Conditions | | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| Input (Port 1) Frequency Range | | | 10 | | 25 | GHz |
| Output (Port 2) Frequency Range | | | 20 | | 50 | |
| Input Power | | | +10 | | +15 | dBm |
| 2F Conversion Loss (CL) | Input = 10 – 25 GHz<br>Output = 20 - 50 GHz | | | 12.5 | 16 | dB |
| Suppression[2,3] | 1F | Input = 10 – 25 GHz<br>Output = 10 - 25 GHz | 25 | 33 | | dBc |
| | 3F | Input = 10 – 17 GHz<br>Output = 30 - 51 GHz | 30 | 40 | | |
| | 4F | Input = 10 – 12.5 GHz<br>Output = 40 - 50 GHz | 8 | 10.5 | | |
| Isolations[4] | 1F | Input = 10 - 25 GHz<br>Output = 10 - 25 GHz | 40 | 45 | | dB |
| | 3F | Input = 10 – 17 GHz<br>Output = 30 - 51 GHz | 42 | 53 | | |
| | 4F | Input = 10 – 12.5 GHz<br>Output = 40 - 50 GHz | 22 | 24.5 | | |

[2] Suppressions and isolations measured with an input source with >60dBc (relative to fundamental input) harmonic suppression

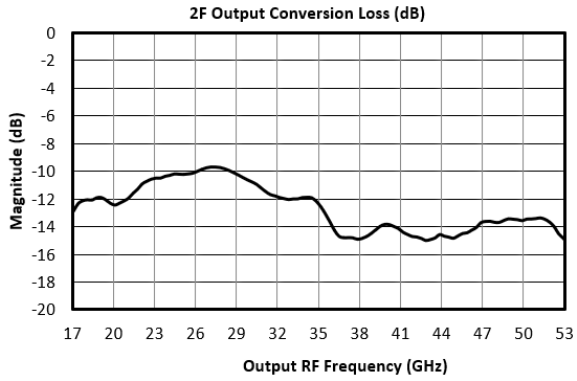
[3] Suppression is defined as the harmonic power relative to the 2F doubled output power

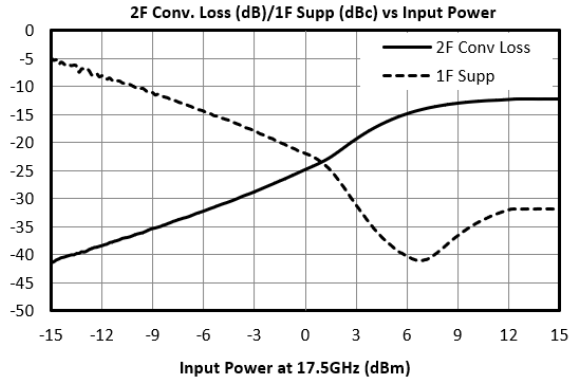
[4] Isolation is defined as the harmonic power relative to the 1F fundamental input power.

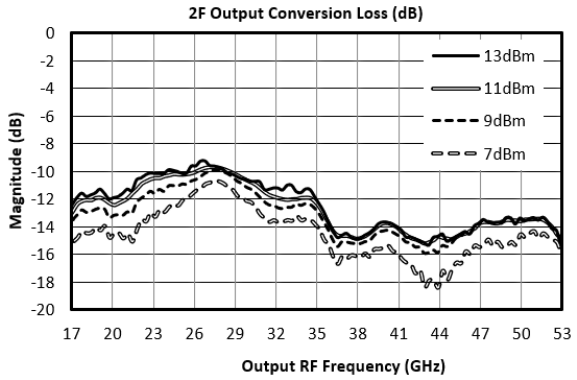
Copyright © 2020 Marki Microwave, Inc.

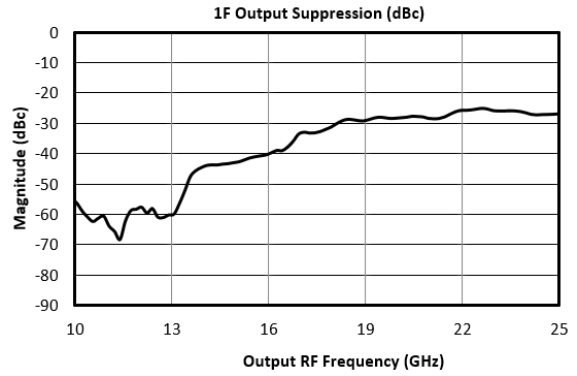
## 3.6 Typical Performance Plots

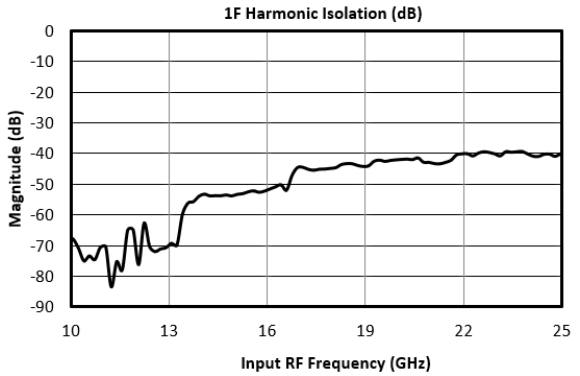
All typical performance data includes fixturing losses from the EVAL package. The actual DUT performs better than the displayed results, especially as the frequency increases.



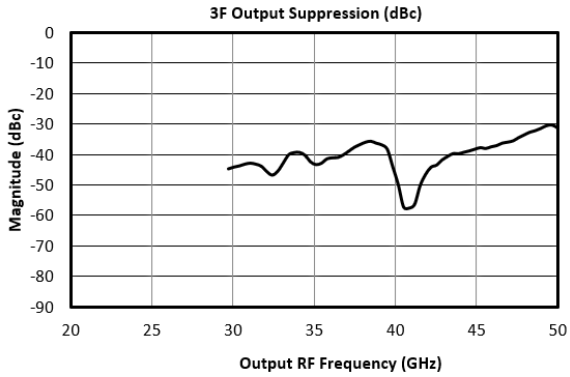



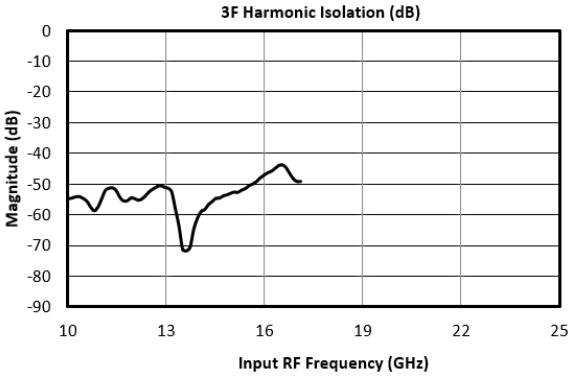



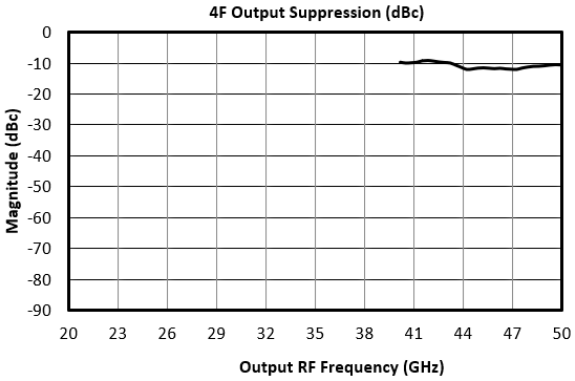



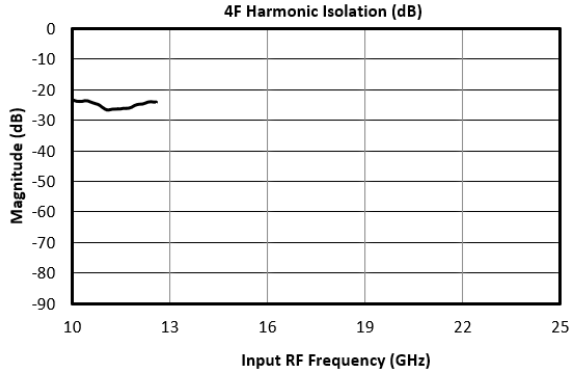



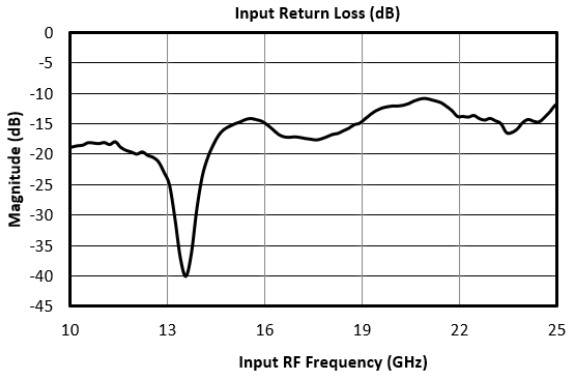

Copyright © 2020 Marki Microwave, Inc.

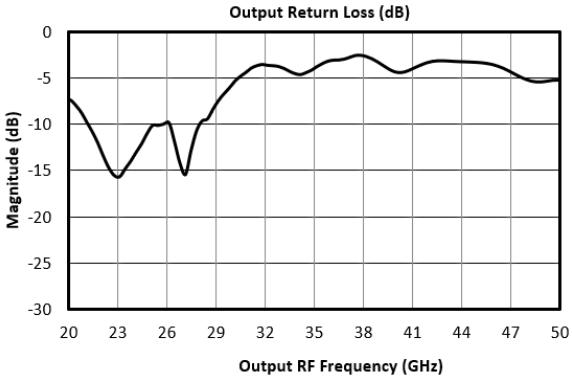


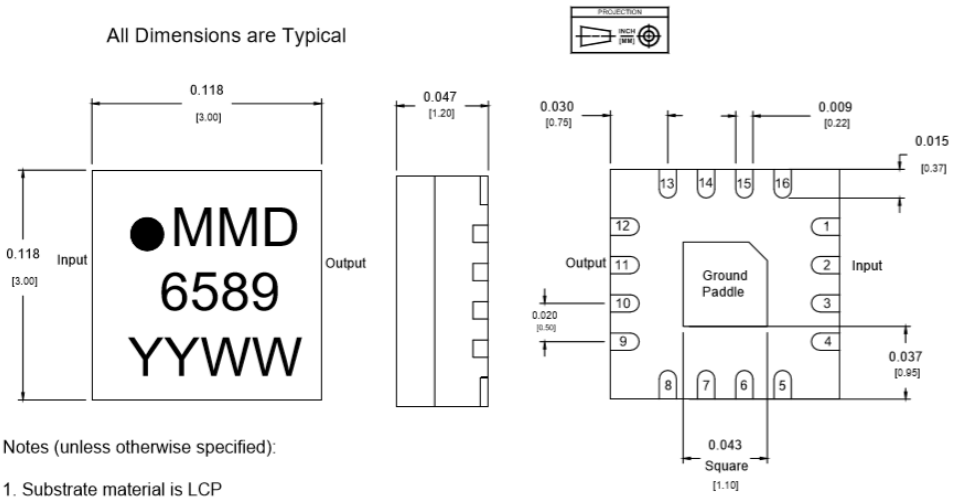




Copyright © 2020 Marki Microwave, Inc.

# 4. Mechanical Data

## 4.1 SM Package Outline Drawing

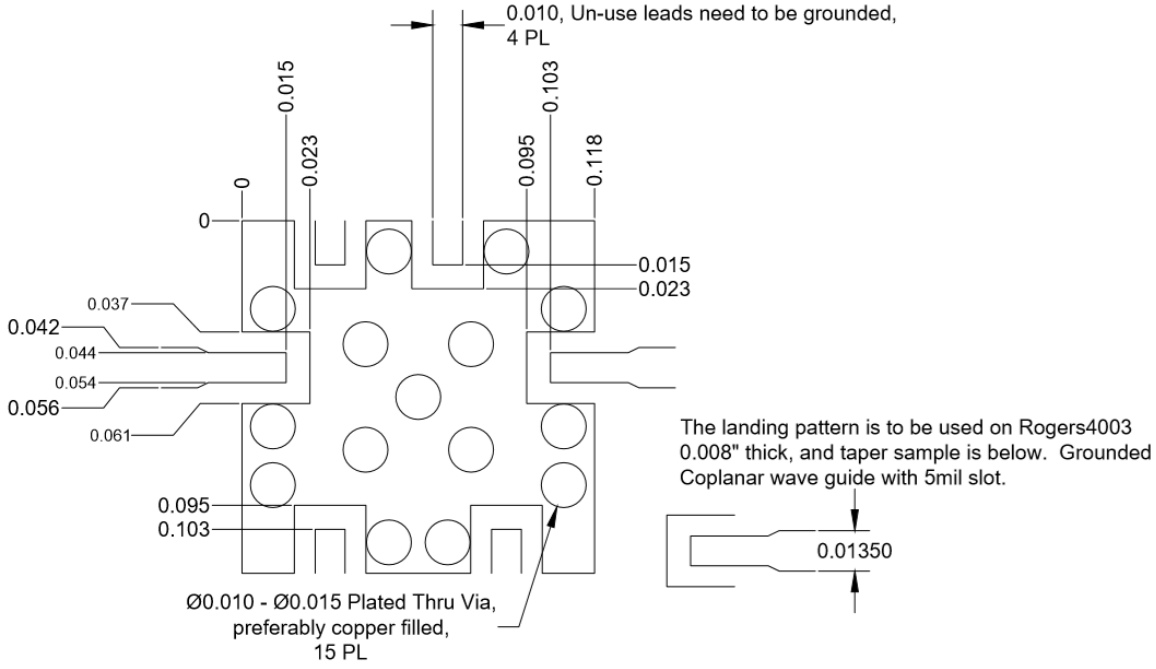
| Pin # | Connection |
|---|---|
| 1 | N/C |
| 2 | Input |
| 3 | N/C |
| 4 | N/C |
| 5 | N/C |
| 6 | N/C |
| 7 | N/C |
| 8 | N/C |
| 9 | N/C |
| 10 | N/C |
| 11 | Output |
| 12 | N/C |
| 13 | N/C |
| 14 | N/C |
| 15 | N/C |
| 16 | N/C |




Notes (unless otherwise specified):

1. Substrate material is LCP
2. I/O Leads and Die Paddle is (from base to finish):
   Ni: 0.5um MIN
   Pd: 0.02um MIN
   Au: 0.05um MAX
3. All unconnected pins should be connected to PCB RF ground.

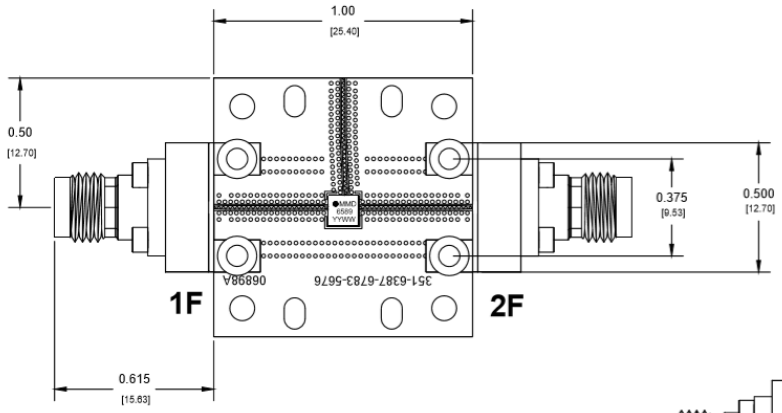
## 4.2 SM Package Footprint




QFN-Package Surface-Mount Landing Pattern
Click here for a DXF of the above layout.
Click here for leaded solder reflow. Click here for lead-free solder reflow

Copyright © 2020 Marki Microwave, Inc.

## 4.3 EVAL Package Outline Drawing

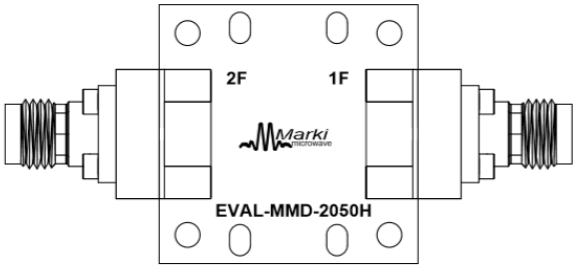


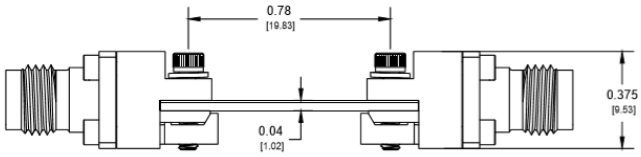

**All measurements are typical**

| Port | Connector Type |
|---|---|
| 1F | 2.92mm Female |
| 2F | 2.40mm Female |

| Port | DC Voltage |
|---|---|
| 1F | 0.691 V |
| 2F | DC Open |

Backside Label




*Marki Microwave reserves the right to make changes to the product(s) or information contained herein without notice. Marki Microwave makes no warranty, representation, or guarantee regarding the suitability of its products for any particular purpose, nor does Marki Microwave assume any liability whatsoever arising out of the use or application of any product.*

Copyright © 2020 Marki Microwave, Inc.