

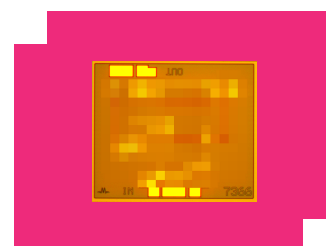
## MMD-1250HCH

### GaAs MMIC Millimeter Wave Doubler

## DEVICE OVERVIEW

### General Description

The MMD-1250H is a MMIC millimeter wave doubler fabricated with GaAs Schottky diodes. This doubler operates over a guaranteed 6 to 25 GHz input frequency range or a doubled output frequency range of 12 to 50 GHz. It features excellent conversion loss, superior isolations, and harmonic suppressions across a broad bandwidth. Both the wire bondable die and connectorized units are available.



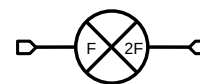
### Features

- High fundamental rejection
- Millimeter wave output frequencies
- Low 2F Conversion Loss

### Applications

- High frequency synthesis
- LO signal chain

### Functional Block Diagram



### Part Ordering Options

| Part Number       | Description                       | Package | Packing Size | Green Status | Product Lifecycle | Export Classification |
|-------------------|-----------------------------------|---------|--------------|--------------|-------------------|-----------------------|
| MMD-1250HCH       | GaAs MMIC Millimeter Wave Doubler | CH      | -            | RoHS         | Released          | EAR99                 |
| <u>MMD-1250HU</u> | GaAs MMIC Millimeter Wave Doubler | U       | -            | RoHS         | Released          | EAR99                 |

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### Revision History

| Revision Code | Revision Date | Comment                   |
|---------------|---------------|---------------------------|
| -             | 2021-04-01    | Datasheet Initial Release |



## Specifications

### 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 | Unit |
|-------------------------------|----------------|------|
| Maximum Operating Temperature | 100            | °C   |
| Maximum Storage Temperature   | 125            | °C   |
| Minimum Operating Temperature | -55            | °C   |
| Minimum Storage Temperature   | -65            | °C   |
| Port 1 DC Current             | 25             | mA   |
| Power Handling, at any Port   | 23             | dBm  |

### Package Information

| Parameter  | Details            | Rating         |
|------------|--------------------|----------------|
| ESD        | 250 to < 500 Volts | HBM Class 1A   |
| Dimensions | -                  | 1.38 x 1.17 mm |

### 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.

| Parameter           | Min | Nominal | Max | Unit |
|---------------------|-----|---------|-----|------|
| Input Power         | 11  | -       | 19  | dBm  |
| Ambient Temperature | -55 | 25      | 100 | °C   |

## 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.

### Electrical Specifications

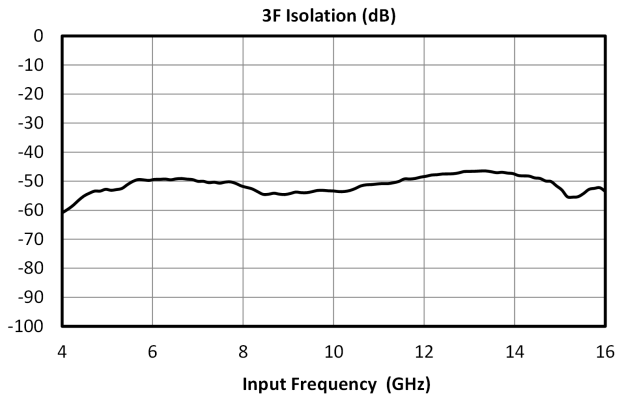
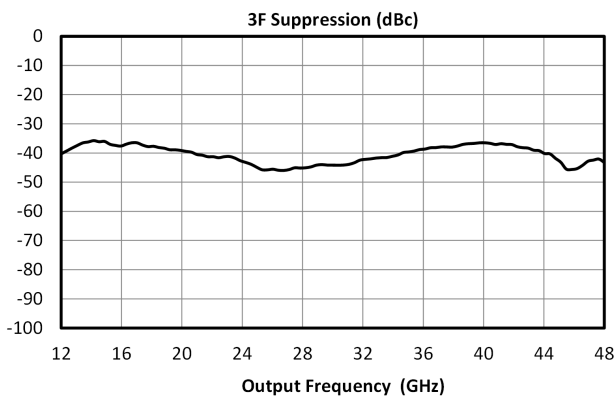
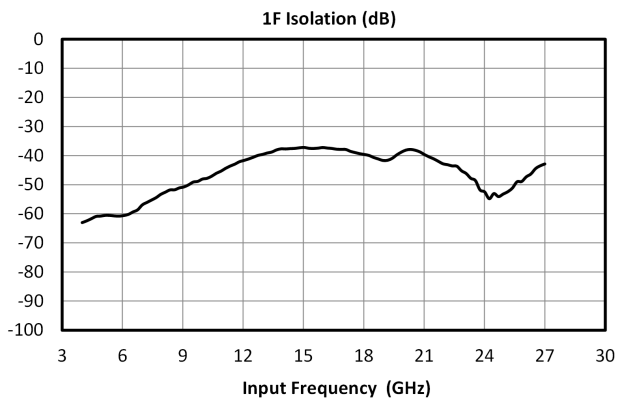
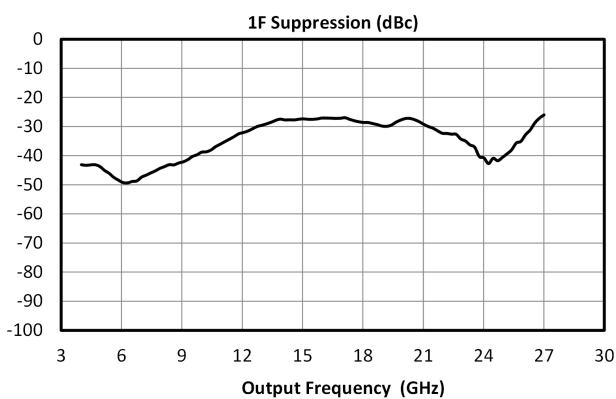
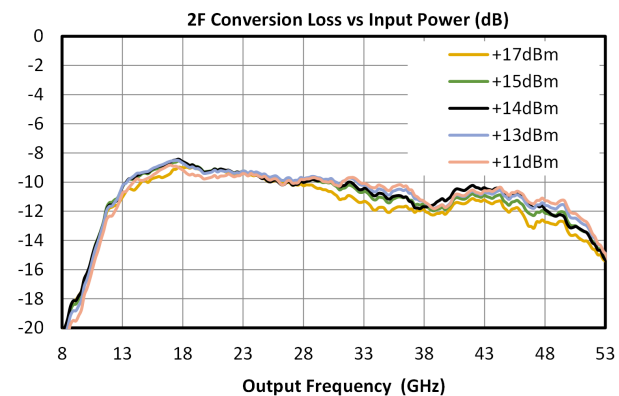
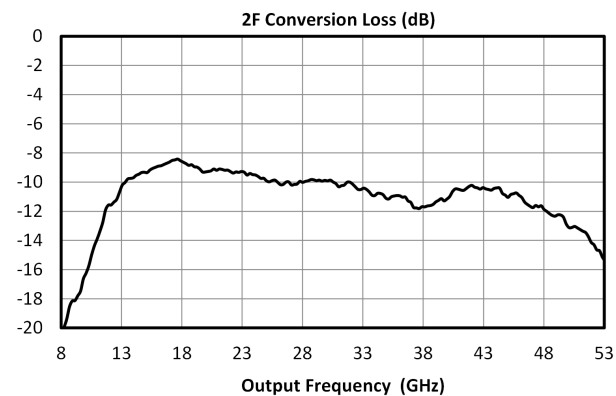
The electrical specifications apply at TA=+25°C in a 50Ω system. Typical data shown is for the connectorized U package doubler used in the forward direction with a +14 dBm sine wave input. Min and Max limits apply only to our connectorized units and are guaranteed at TA=+25°C. RF testing of our die is performed on a sample basis to verify conformance to datasheet guaranteed specifications.

| Parameter                    | Test Conditions                            | Minimum Frequency (GHz) | Maximum Frequency (GHz) | Min | Typ | Max | Unit |
|------------------------------|--------------------------------------------|-------------------------|-------------------------|-----|-----|-----|------|
| Conversion Loss              | Second Harmonic Output                     | 12                      | 50                      | -   | 10  | 15  | dB   |
| Input Frequency Range        | -                                          | -                       | -                       | 6   | -   | 25  | GHz  |
| Input Power                  | -                                          | -                       | -                       | 11  | -   | 19  | dBm  |
| Isolation, 1F <sup>1</sup>   | Input = 6 – 25 GHz<br>Output = 6 – 25 GHz  | 6                       | 25                      | -   | 42  | -   | dB   |
| Isolation, 3F <sup>2</sup>   | Input = 6 – 16 GHz<br>Output = 18 – 48 GHz | 18                      | 48                      | -   | 50  | -   | dB   |
| Output Frequency Range       | -                                          | -                       | -                       | 12  | -   | 50  | GHz  |
| Suppression, 1F <sup>3</sup> | Input = 6 – 25 GHz<br>Output = 6 – 25 GHz  | 6                       | 25                      | -   | 32  | -   | dBc  |
| Suppression, 3F <sup>4</sup> | Input = 6 – 16 GHz<br>Output = 18 – 48 GHz | 18                      | 48                      | -   | 40  | -   | dBc  |

<sup>[1][2]</sup> Isolation is defined as the harmonic power relative to the 1F fundamental input power.

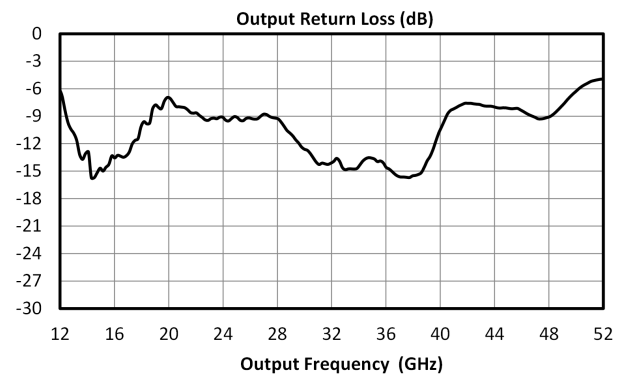
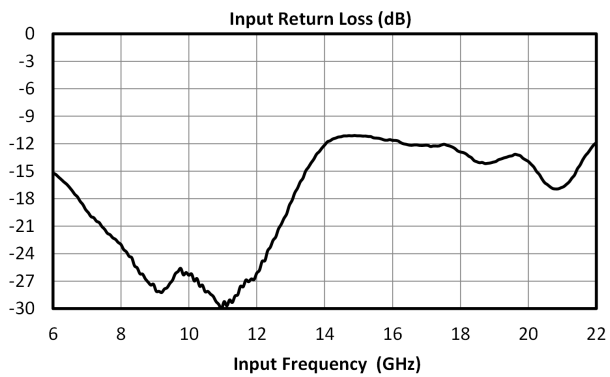
<sup>[3][4]</sup> Suppressions and isolations measured with an input source with >60dBc (relative to fundamental input) harmonic suppression. Suppression is defined as the harmonic power relative to the 2F doubled output power.

## Typical Performance Plots



## MMD-1250HCH

### GaAs MMIC Millimeter Wave Doubler



## Die Mounting Recommendations

### Mounting and Bonding Recommendations

Marki MMICs should be attached directly to a ground plane with conductive epoxy. The ground plane electrical impedance should be as low as practically possible. This will prevent resonances and permit the best possible electrical performance. Datasheet performance is only guaranteed in an environment with a low electrical impedance ground.

**Mounting** - To epoxy the chip, apply a minimum amount of conductive epoxy to the mounting surface so that a thin epoxy fillet is observed around the perimeter of the chip. Cure epoxy according to manufacturer instructions.

**Wire Bonding** - Ball or wedge bond with 0.025 mm (1 mil) diameter pure gold wire. Thermosonic wirebonding with a nominal stage temperature of 150 °C and a ball bonding force of 40 to 50 grams or wedge bonding force of 18 to 22 grams is recommended. Use the minimum level of ultrasonic energy to achieve reliable wirebonds. Wirebonds should be started on the chip and terminated on the package or substrate. All bonds should be as short as possible <0.31 mm (12 mils).

**Circuit Considerations** – 50  $\Omega$  transmission lines should be used for all high frequency connections in and out of the chip. Wirebonds should be kept as short as possible, with multiple wirebonds recommended for higher frequency connections to reduce parasitic inductance. In circumstances where the chip more than .001" thinner than the substrate, a heat spreading spacer tab is optional to further reduce bondwire length and parasitic inductance.

## Handling Precautions

### General Handling

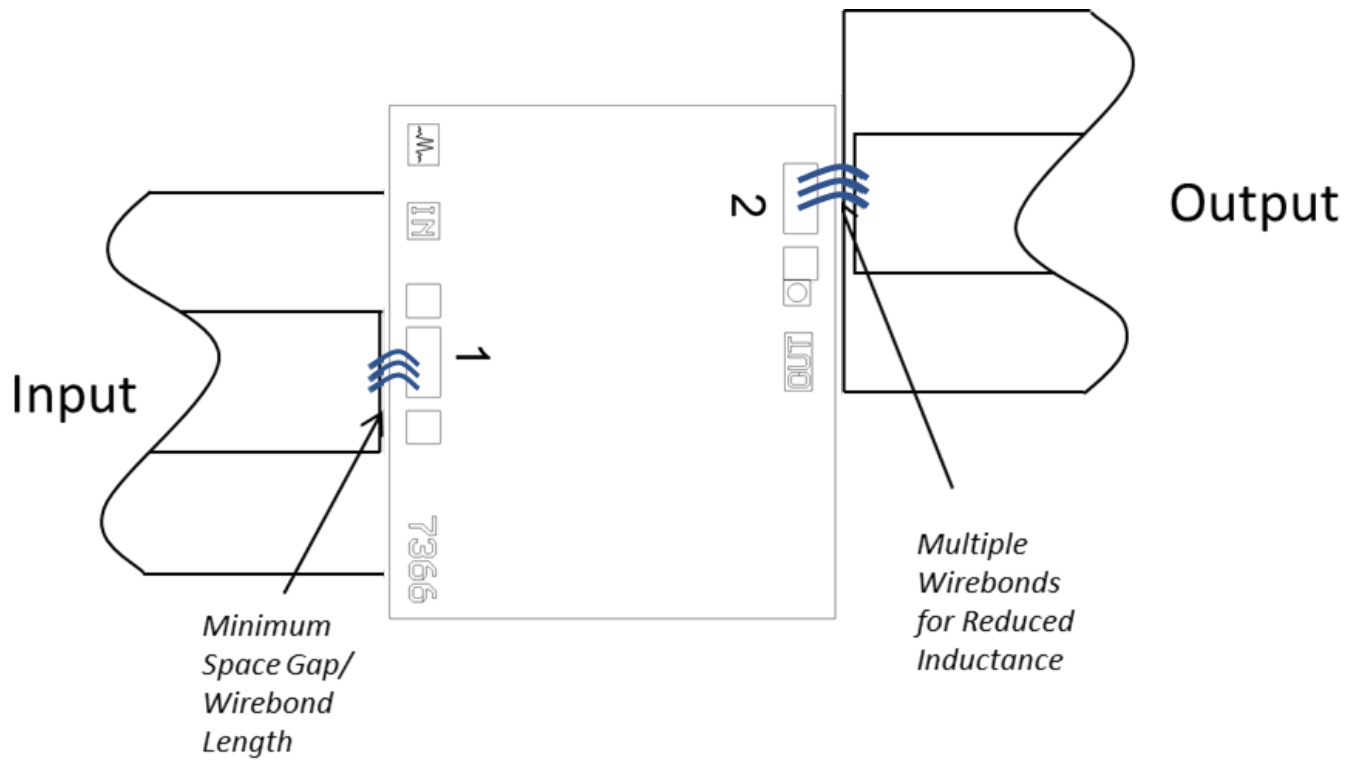
Chips should be handled with care using tweezers or a vacuum collet. Users should take precautions to protect chips from direct human contact that can deposit contaminants, like perspiration and skin oils on any of the chip's surfaces.

### Static Sensitivity

GaAs MMIC devices are sensitive to ESD and should be handled, assembled, tested, and transported only in static protected environments.

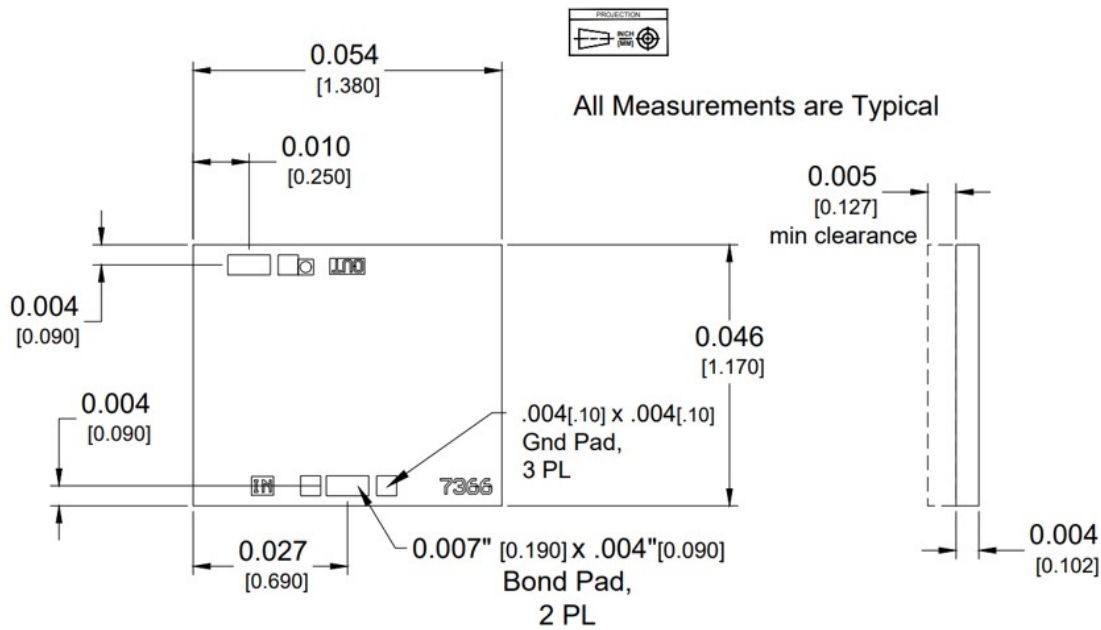
**Cleaning and Storage:** Do not attempt to clean the chip with a liquid cleaning system or expose the bare chips to liquid. Once the ESD sensitive bags the chips are stored in are opened, chips should be stored in a dry nitrogen atmosphere.

**Bonding Diagram**



### Mechanical Data

### Outline Drawing



1. CH Substrate material is 0.004 in thick GaAs
2. I/O trace finish is 4 microns Au. Ground plane finish is 5 microns Au.
3. Tolerance for X, Y dimensions is  $\pm 0.002$  in. Tolerance for Z dimension is  $\pm 0.0005$  in. Tolerance for pad location is  $\pm 0.0001$  in

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