Sales: 408-778-9952 | General: 408-778-4200 | Fax: 408-778-4300
Sales & Customer Support: sales@markimicrowave.com
Tech Support: support@markimicrowave.com
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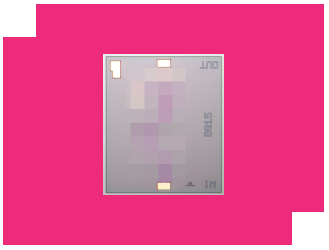
MMD-40120HCH

GaAs MMIC Millimeter Wave Doubler

DEVICE OVERVIEW

General Description

MMD-40120H is a MMIC millimeter wave 2x multiplier fabricated with GaAs Schottky diodes. MMD-40120H operates over a 20 to 60 GHz input frequency range or a doubled output frequency range of 40 to 120 GHz. MMD-40120H is available as a connectorized coaxial module using 1.0 mm connectors on the output. Wire bondable die are also available



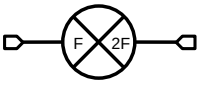
Features

- Low input power requirement
- Low loss die and package
- Up to 120GHz 2nd harmonic output tone
- Coax connector module

Applications

- mmWave frequency synthesis
- LO signal chain for mmWave mixers

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Packing Size	Green Status	Product Lifecycle	Export Classification
MMD-40120HM	GaAs MMIC Millimeter Wave Doubler	M	-	RoHS	Released	3A001.b.7.b.1
MMD-40120HCH	GaAs MMIC Millimeter Wave Doubler	CH	-	RoHS	Released	3A001.b.7.b.1

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Table Of Contents

Revision History

Revision Code	Revision Date	Comment
-	2022-11-01	Initial Datasheet Release

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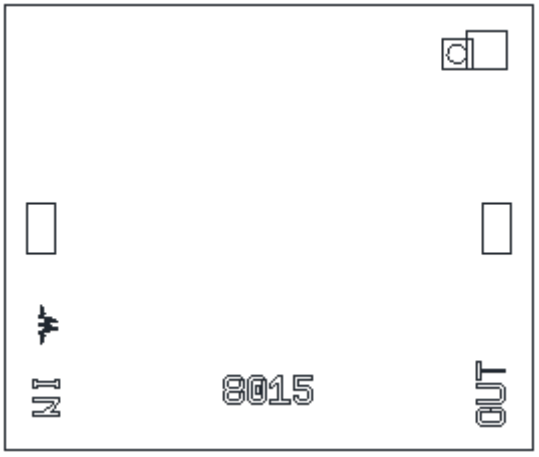
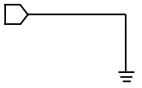
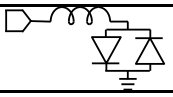
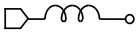
Port Configuration and Functions

Port Diagram

A top-down view of the MMD-40120H's CH package outline drawing is shown below. The MMD-40120H should only be used in the forward direction, with the input and output ports given in Port Functions



Port Functions

Port	Function	Description	Equivalent Circuit for Package
GND	Ground	CH package ground path is provided through the substrate and ground bond pads. M package ground provided through metal housing and outer coax conductor.	
Port 1	Input	Input x1 Frequency Port.Port 1 is DC coupled to the diodes for the CH and M packages. Blocking capacitor is optional.	
Port 2	Output	2x Input Frequency output port.Port 2 is DC open for the CH and M package	

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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 lifetimeThe 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	25	dBm

Package Information

Parameter	Details	Rating
ESD	250 to < 500 Volts	HBM Class 1A
Dimensions	-	1.17 x 1.38 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	10	12	15	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.

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Electrical Specifications

The electrical specifications apply at TA=+25°C in a 50Ω system. Typical data shown is for the connectorized M package doubler used in the forward direction with a nominal +12 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
2F Output Power	Input = 20 – 60 GHz Output = 40 - 120 GHz	40	120	-	2	-	dBm
Conversion Loss	Second Harmonic Output	40	120	-	10	15	dB
Input Frequency Range	-	-	-	20	-	60	GHz
Input Power	-	-	-	10	12	15	dBm
Isolation, 1F [1]	Input = 20 – 60 GHz Output = 20 – 60 GHz	20	60	-	40	-	dB
Isolation, 3F [2]	Input = 20 – 40 GHz Output = 60 – 120 GHz	60	120	-	50	-	dB
Isolation, 4F [3]	Input = 20 – 30 GHz Output = 80 – 120 GHz	80	120	-	25	-	dB
Output Frequency Range [4]	-	-	-	40	-	120	GHz
Suppression, 1F [5]	Input = 20 – 60 GHz Output = 20 – 60 GHz	20	60	-	30	-	dBc
Suppression, 3F [6]	Input = 20 – 40 GHz Output = 60 – 120 GHz	60	120	-	40	-	dBc
Suppression, 4F [7]	Input = 20 – 30 GHz Output = 80 – 120 GHz	80	120	-	15	-	dBc

[1][2][3] Isolation is defined as the harmonic power relative to the 1F fundamental input power.
[4] Output return loss measured with a fixed frequency large signal 67 GHz input.
[5][6][7] 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.

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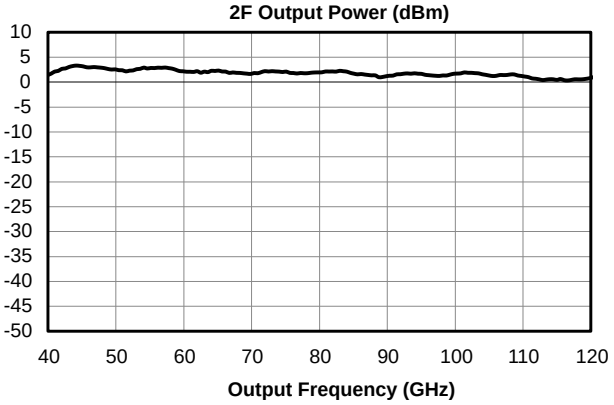
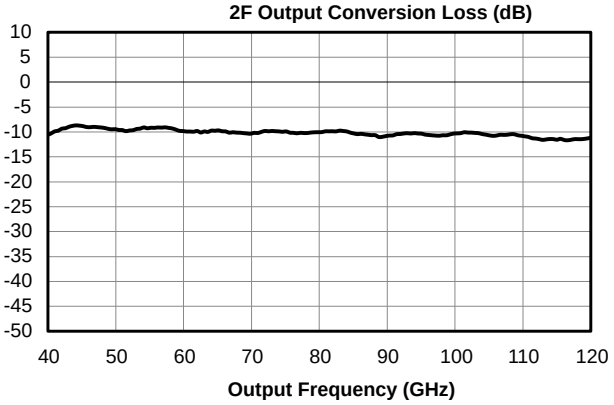
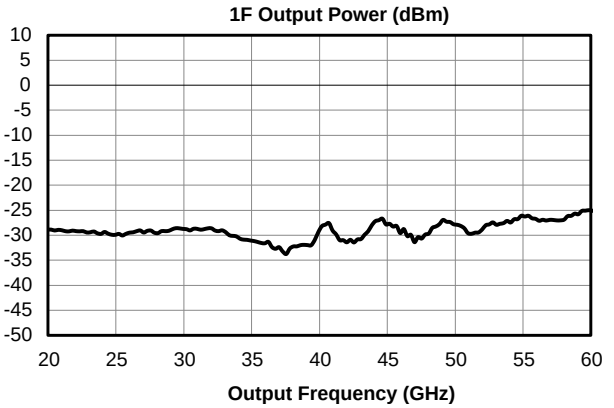
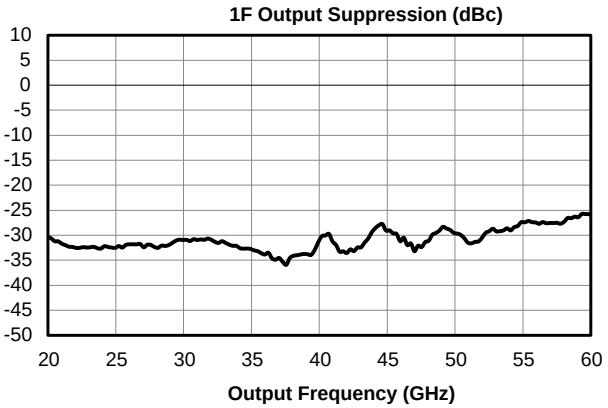
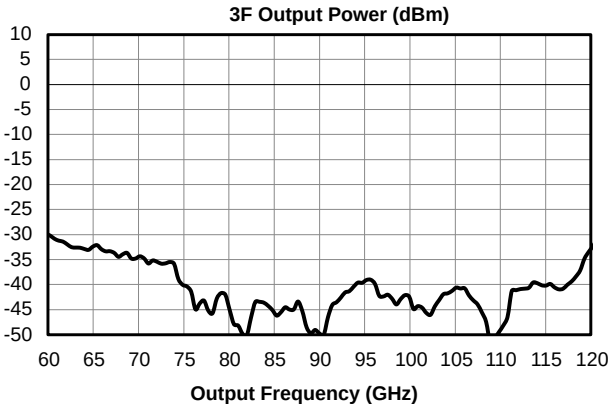
Typical Performance Plots

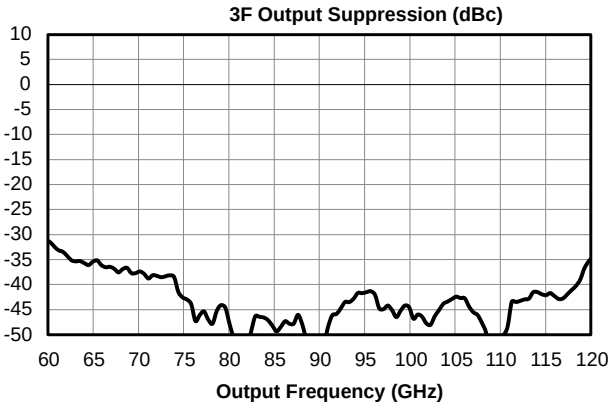












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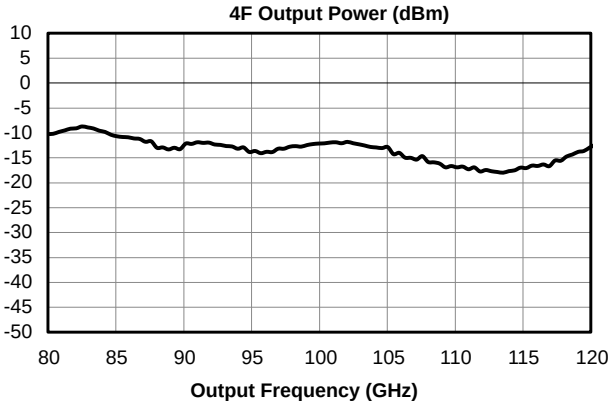

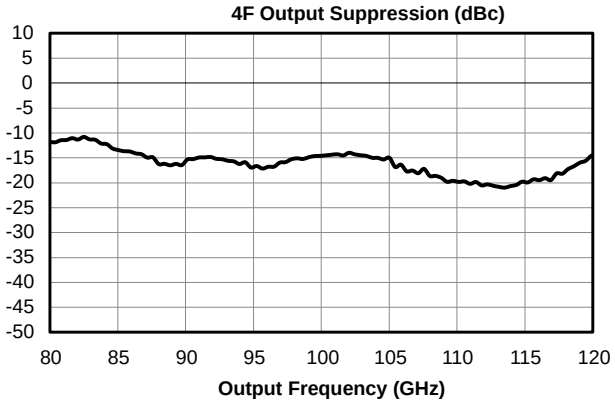

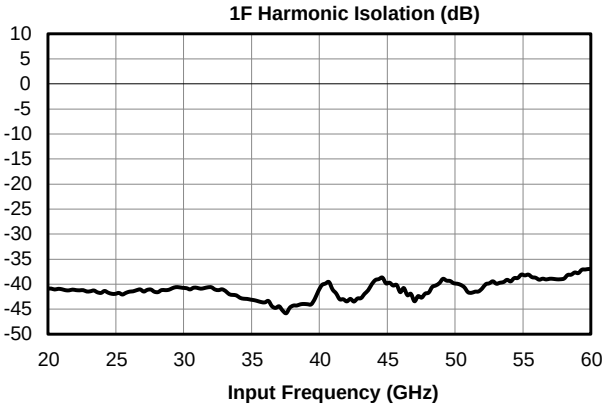

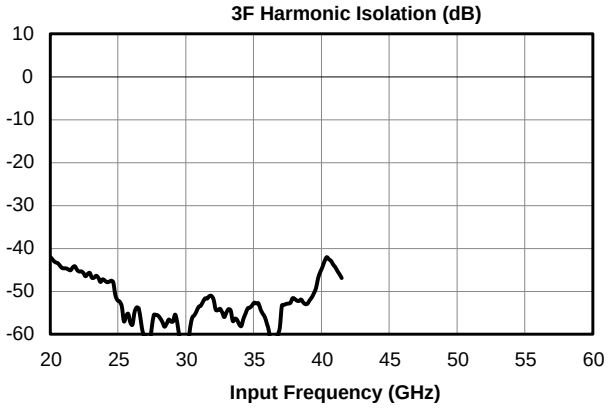

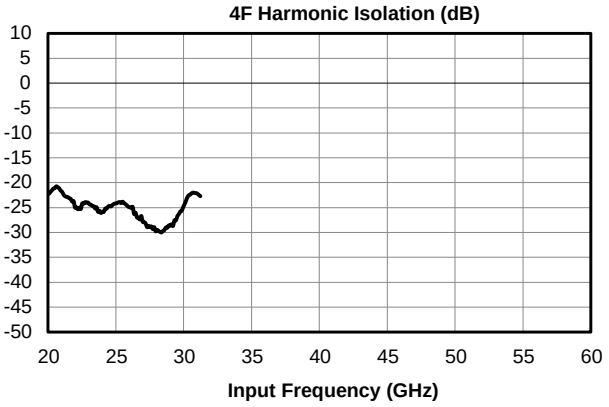

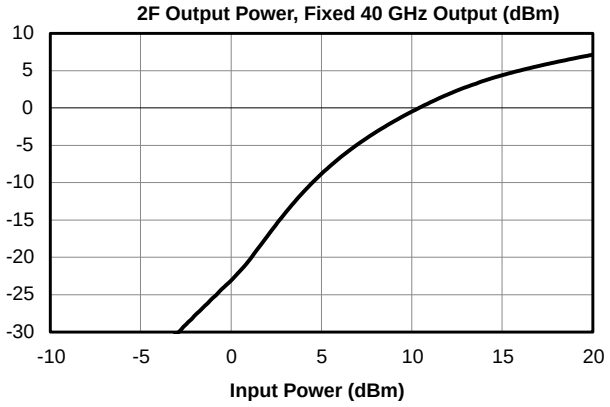

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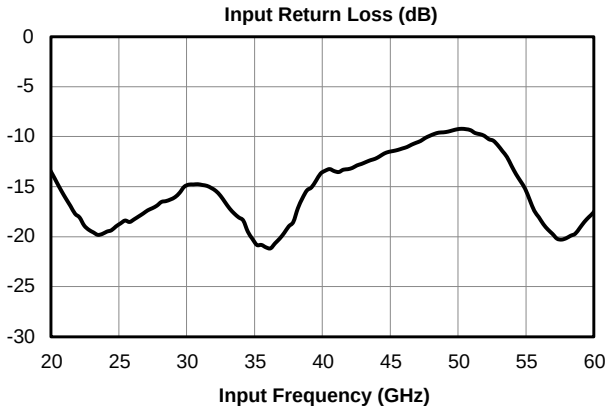

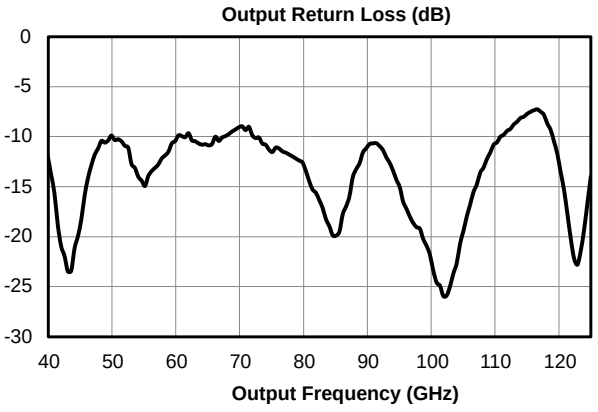

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Die Mounting Recommendations

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 Ω 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.

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.

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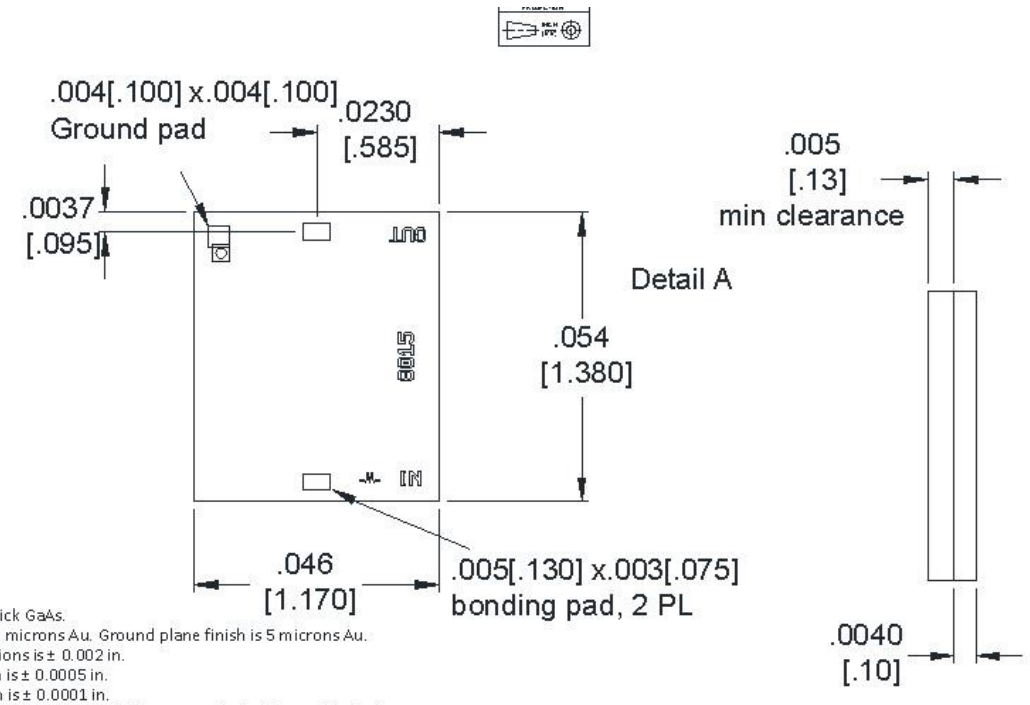
Mechanical Data

Outline Drawing



Notes:
1. CH substrate is .004 in Thick GaAs.
2. I/O traces plane finish is 4 microns Au. Ground plane finish is 5 microns Au.
3. Tolerance for X, Y dimensions is ± 0.002 in.
   Tolerance for Z dimension is ± 0.0005 in.
   Tolerance for pad location is ± 0.0001 in.
4. Electrical spec is not guaranteed, all simulations presented at tapeout is best effort.
5. Designed PCB transition is a 125 um thick RO5880 microstrip bondwired to the bondpad. 3x bondwires have a 50 um loop height each.
   a. Other PCB transitions are OK, minimize loop height and other high impedance transitional effects.
   b. Minimize air gap between chip and PCB. Designed with 25 um air gap.
   c. Designed PCB transition does not connect to GND bondpad.

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