

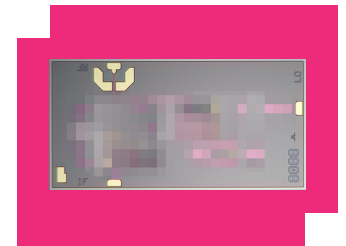
MMH-35120HCH-2

GaAs MMIC Balanced mmWave Harmonic Mixer

DEVICE OVERVIEW

General Description

MMH-35120H is a GaAs MMIC balanced harmonic mixer that features excellent conversion loss, superior isolations, and spurious performance across an incredibly broad bandwidth utilizing the 3rd harmonic of the LO. The MMH-35120H works well as both an up and down converter from the Ka band through mmWave/G band. The MMH-35120H is recommended for mmWave frequency conversion applications where a mmWave LO source may not be available. It is available as both wire bondable die and as a connectorized module.



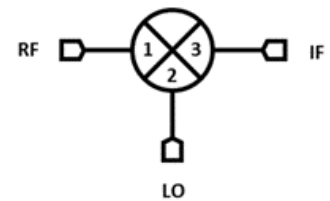
Features

- Ultra-broadband, mmWave frequency conversion
- Efficient frequency conversion utilizing 3xLO harmonic
- High LO to RF isolation

Applications

- mmWave Frequency Conversion
- Test and Measurement Equipment
- Automotive Radar
- 5G transceivers
- mmWave Tuner Mixer

Functional Block Diagram



Part Ordering Options

Part Number	Description	Package	Connectors	Green Status	Product Lifecycle	Export Classification
<u>MMH-35120HM</u>	GaAs MMIC Balanced mmWave Harmonic Mixer	M	<u>Standard</u>	REACH RoHS	Released	3A001.b.7.c.1
MMH-35120HCH-2	GaAs MMIC Balanced mmWave Harmonic Mixer	CH	-	REACH RoHS	Released	3A001.b.7.c.1

MMH-35120HCH-2

GaAs MMIC Balanced mmWave Harmonic Mixer

Table Of Contents

- **Device Overview**
 - General Description
 - Features
 - Applications
 - Functional Block Diagram
- **Port Configuration and Functions**
 - Port Diagram
 - Port Functions
- **Revision History**
- **Specifications**
 - Absolute Maximum Ratings
 - Package Information
 - Recommended Operating Conditions
 - Sequencing Requirements
 - Electrical Specifications
 - Typical Performance Plots
 - MMH-35120HM Typical Performance Plots
- **Die Mounting Recommendations**
 - Mounting and Bounding Recommendations
- **Operation**
 - Application Information
- **Mechanical Data**
 - Outline Drawing

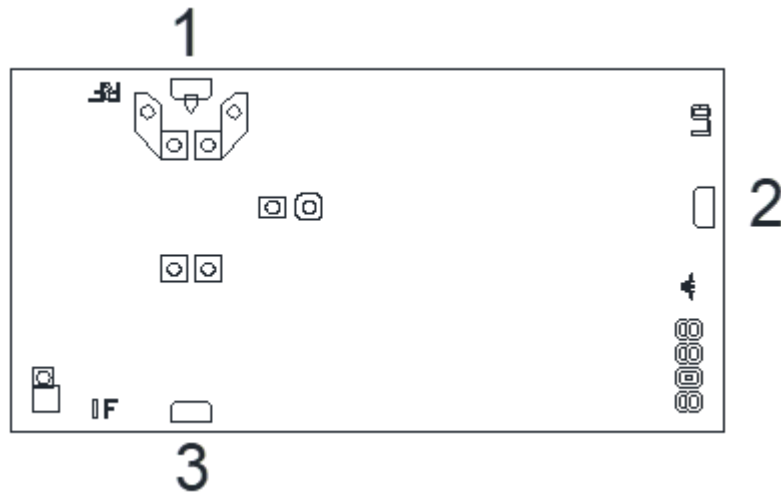
Revision History

Revision Code	Revision Date	Comment
-	2023-01-01	Datasheet Initial Release





Port Configuration and Functions

Port Diagram

A top-down view of the MMH-35120H's CH package outline drawing is shown below. The MMH-35120H has the input and output ports given in Port Functions. The MMH-35120H can be used in either an up or down conversion. For operation, input the LO into port 2, use port 1 for the RF, and port 3 for the IF.



Port Functions

Port	Function	Description	Equivalent Circuit for Package
GND	Ground	CH package ground path is provided through the substrate and ground bond pads.	GND 
Port 1	RF	Port 1 is DC open for the CH and M packages.	P1 
Port 2	LO	Port 2 is diode connected for the CH and M package.	P2 
Port 3	IF	Port 3 is diode connected for the CH and M package.	P3 

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 2 DC Current Handling	30	mA
Port 3 DC Current Handling	30	mA

Package Information

Parameter	Details	Rating
ESD	250 to < 500 Volts	HBM Class 1A
Dimensions	-	2.71 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
Ambient Temperature	-55	25	100	°C
LO Input Power	13	15	17	dBm

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 mixer that requires no DC bias.

Electrical Specifications

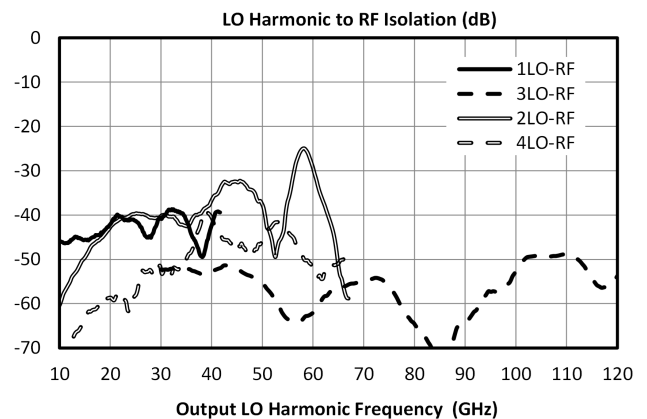
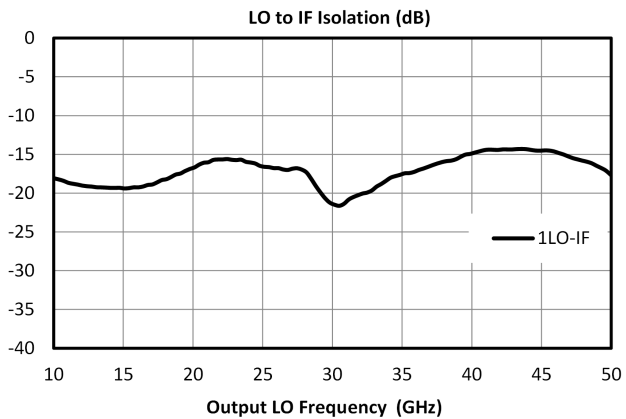
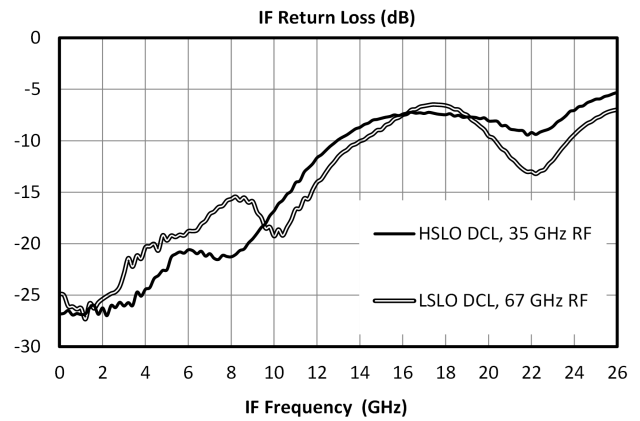
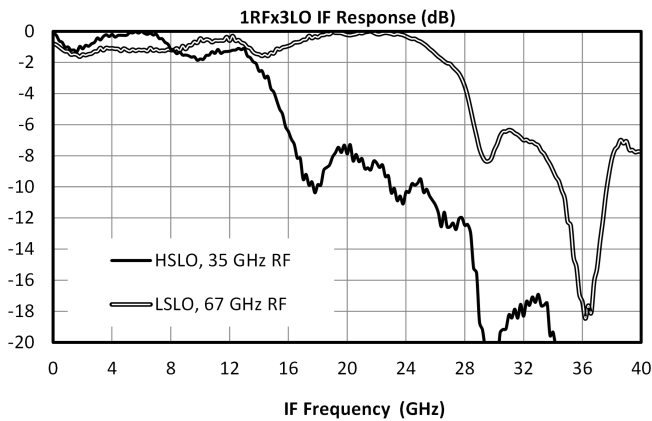
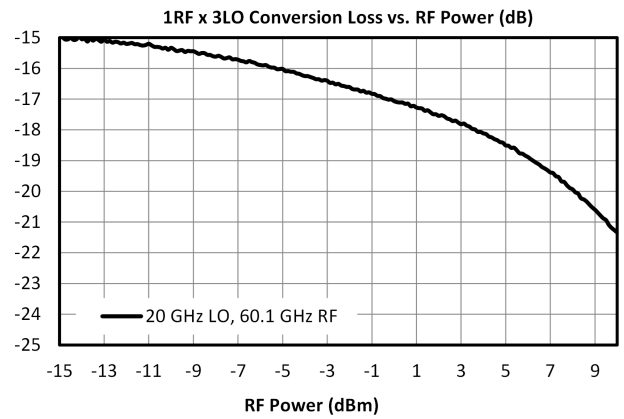
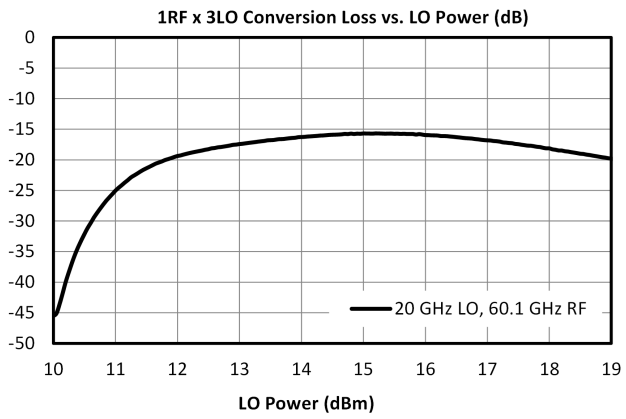
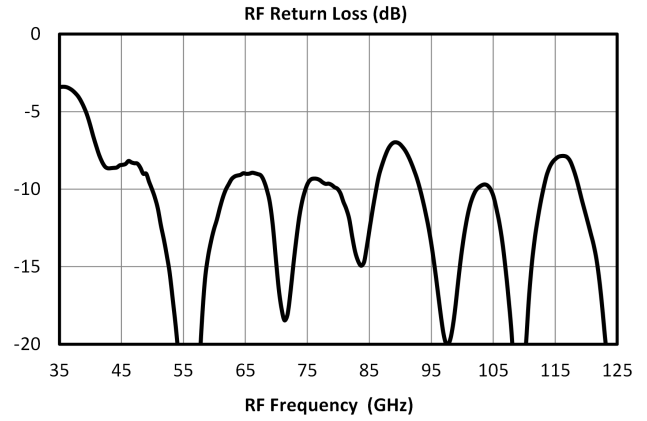
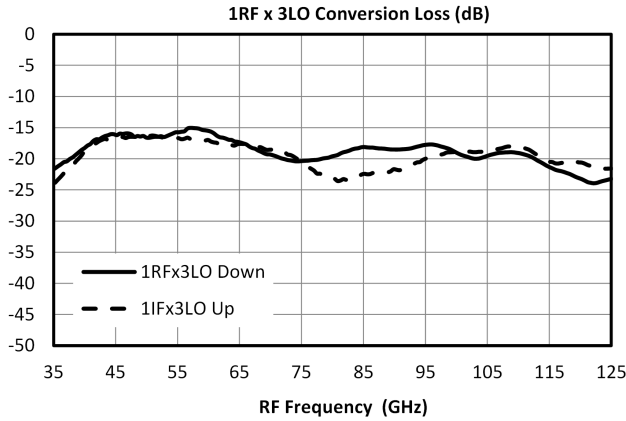
The electrical specifications apply at TA=+25°C in a 50Ω system. Typical data shown is for the connectorized M package mixer used in the forward direction with a +15dBm sine wave LO input. Min and Max limits apply only to our connectorized units and are guaranteed at TA=+25°C. All bare die are 100% DC tested and visually inspected.

Parameter	Test Conditions	Min	Typ	Max	Unit
1x1L Conversion Loss	RF = 35 – 50 GHz LO = 35 – 50 GHz IF = 91 MHz	-	15	-	dB
1x2L Suppression	-	-	22	-	dBc
1x3L Conversion Loss ¹	RF = 35 – 120 GHz LO = 12 – 40 GHz IF = 91 MHz	-	18	-	dB
1x4L Suppression	-	-	30	-	dBc
3LO to RF Isolation	-	-	57	-	dB
IF Frequency Range	-	0	-	14	GHz
Input IP3	-	-	7	-	dBm
IP1dB	-	-	-5	-	dBm
Isolation, LO to RF	-	-	57	-	dB
LO Frequency Range	-	12	-	40	GHz
Noise Figure ²	RF = 35 – 120 GHz LO = 12 – 40 GHz IF = 91 MHz	-	18.5	-	dB
RF Frequency Range	-	35	-	120	GHz

^[1] Measured as a down converter to a fixed 91MHz IF.

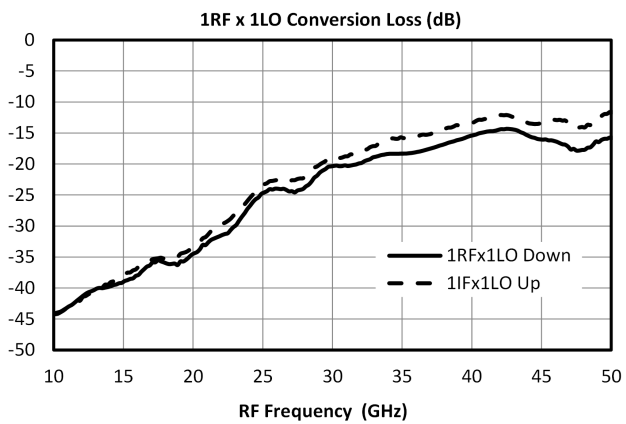
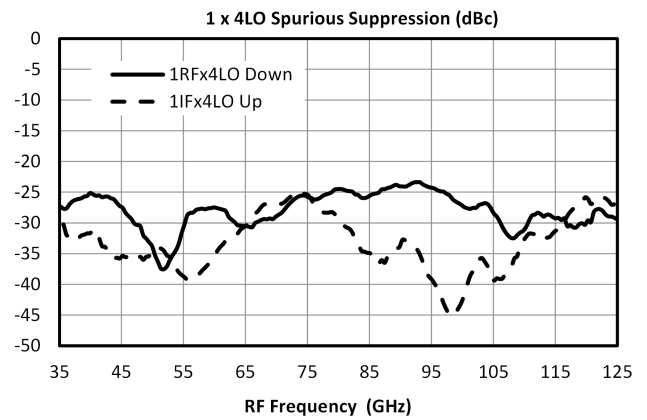
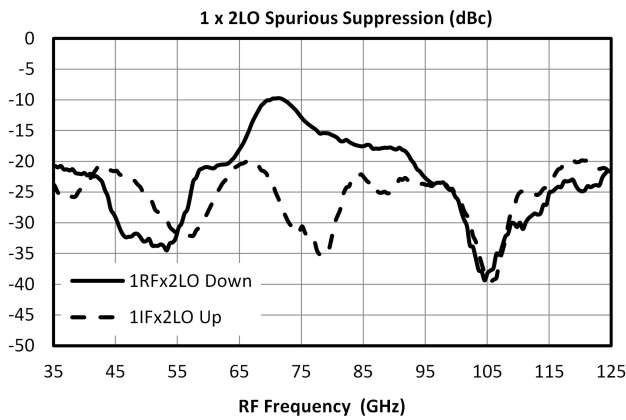
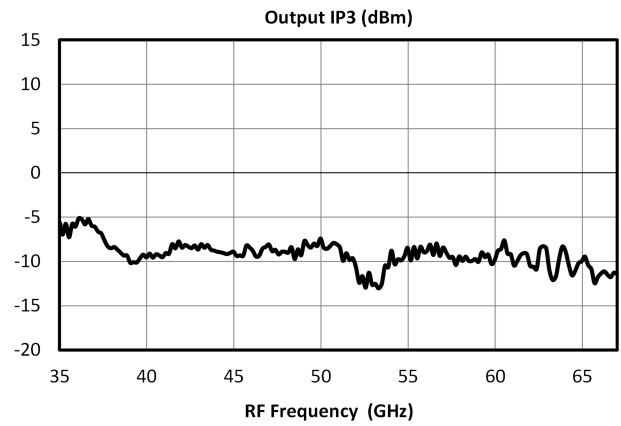
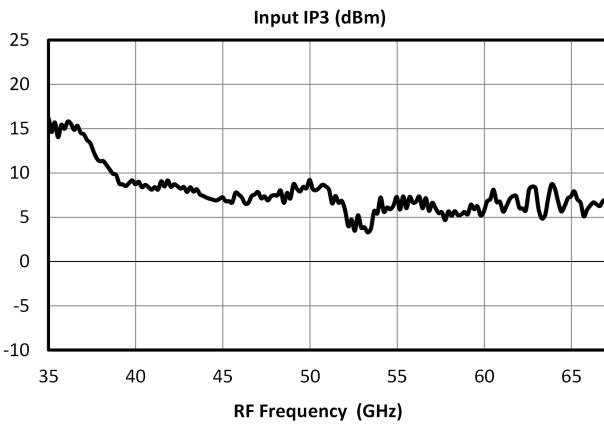
^[2] Mixer Noise Figure typically measures within 0.5 dB of conversion loss for IF frequencies greater than 5 MHz.

Typical Performance Plots



MMH-35120HCH-2

GaAs MMIC Balanced mmWave Harmonic Mixer

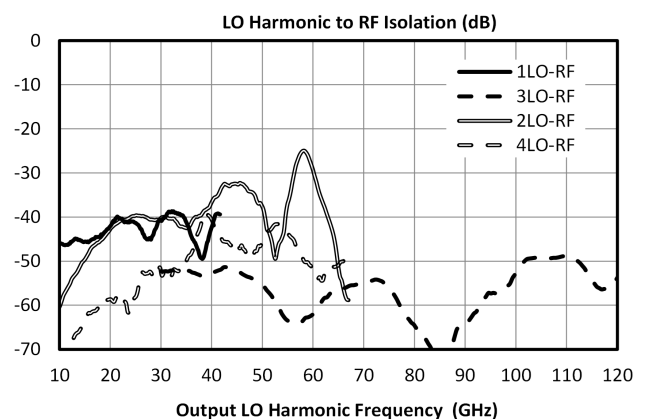
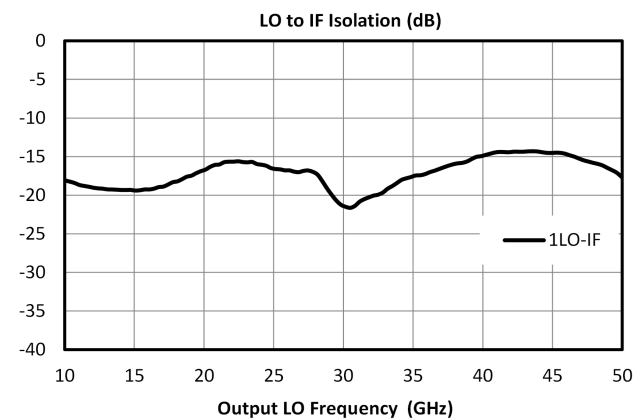
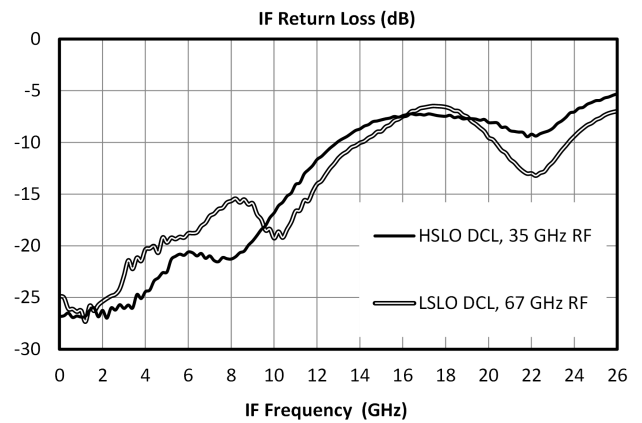
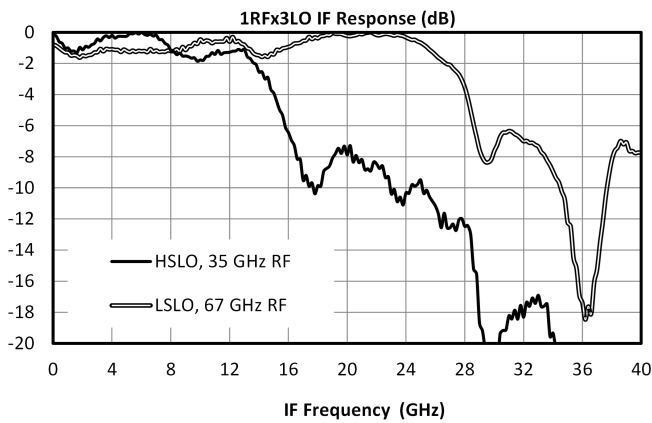
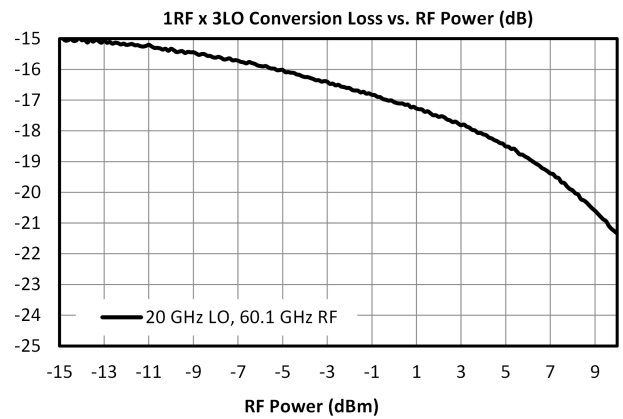
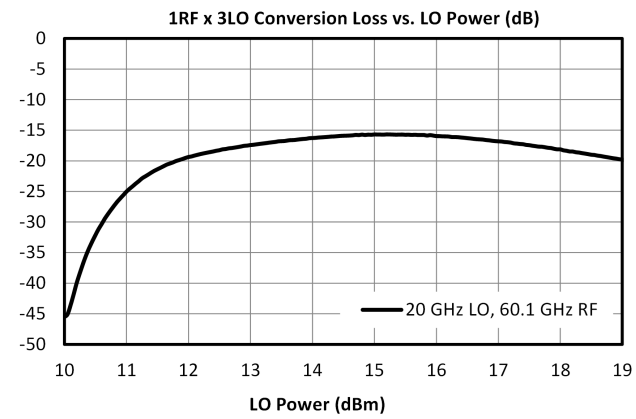
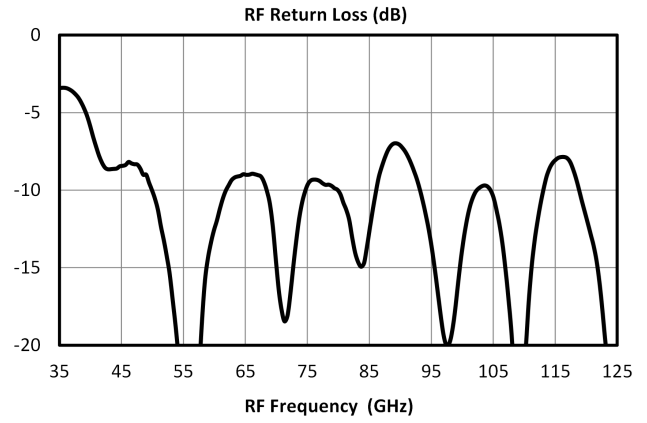
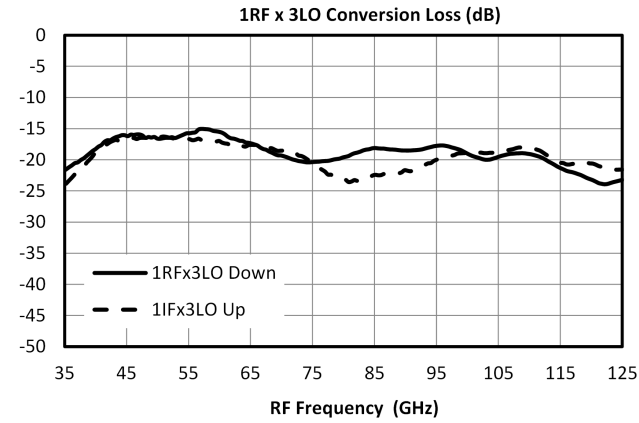


MMH-35120HCH-2

GaAs MMIC Balanced mmWave Harmonic Mixer

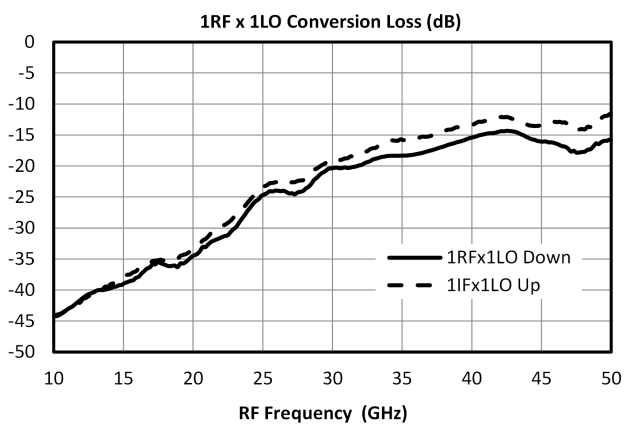
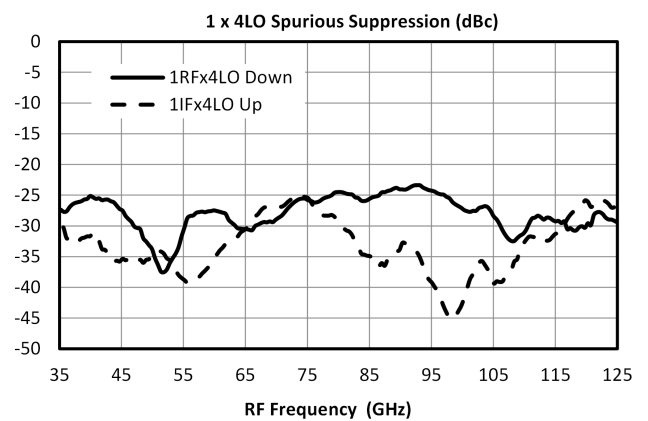
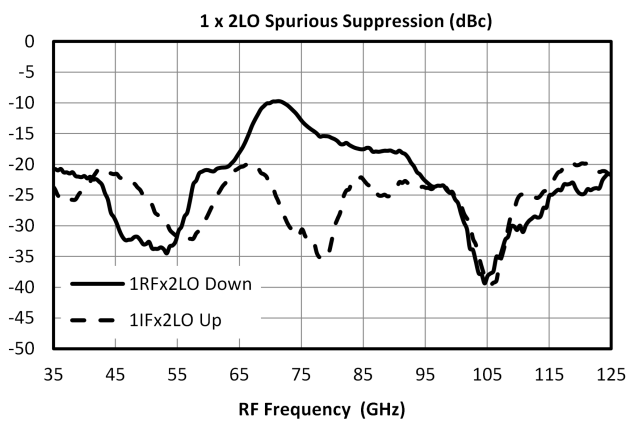
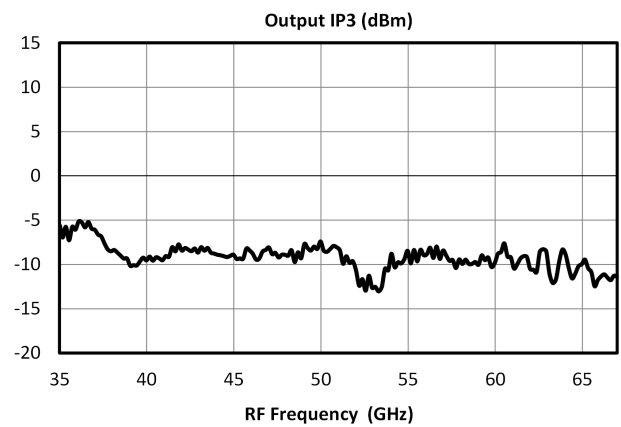
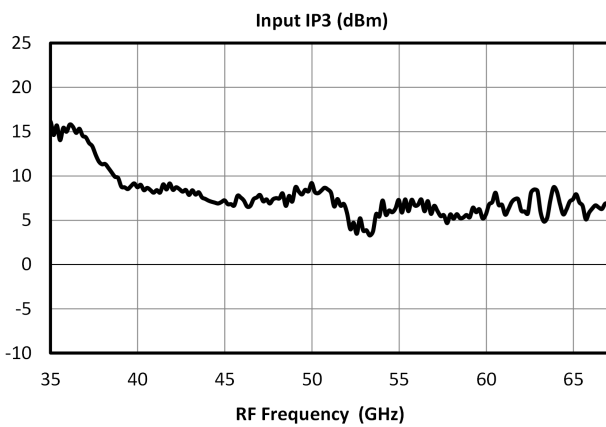
MMH-35120HM - Typical Performance Plots

Performance plots for the connectorized module are shown for measurements where directly probed measurements of the die are unavailable. Note that the following measurements include losses from connectors and microstrip traces.



MMH-35120HCH-2

GaAs MMIC Balanced mmWave Harmonic Mixer



MMH-35120HCH-2

GaAs MMIC Balanced mmWave Harmonic Mixer

Application Information

Typical Operation

The MMH-35120H is a subharmonic mixer meaning the mixer is designed for optimal conversion efficiency of the $1 \times 3LO$ tone. This means that integrated into the mixer is a $3x$ multiplier circuit on the LO path so that the user does not need to generate high powered mmWave LO tones. To operate this mixer as an upconverter, inject your small signal input into port 3 (IF port) and select an LO tone to inject into port 2 (LO port) such that the output tone will be at a frequency of $1IF+3LO$ on port 1 (RF port). Likewise, to operate this mixer as a downconverter one should inject their small signal mmWave tone into port 1 (RF port), and select an LO tone for port 2 (LO port) such that the down converted tone is at $1RF-3LO$ or $3LO-1RF$ on port 3 (IF port).

MMH-35120HCH-2

GaAs MMIC Balanced mmWave Harmonic Mixer

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. 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.

MMH-35120HCH-2

GaAs MMIC Balanced mmWave Harmonic Mixer

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

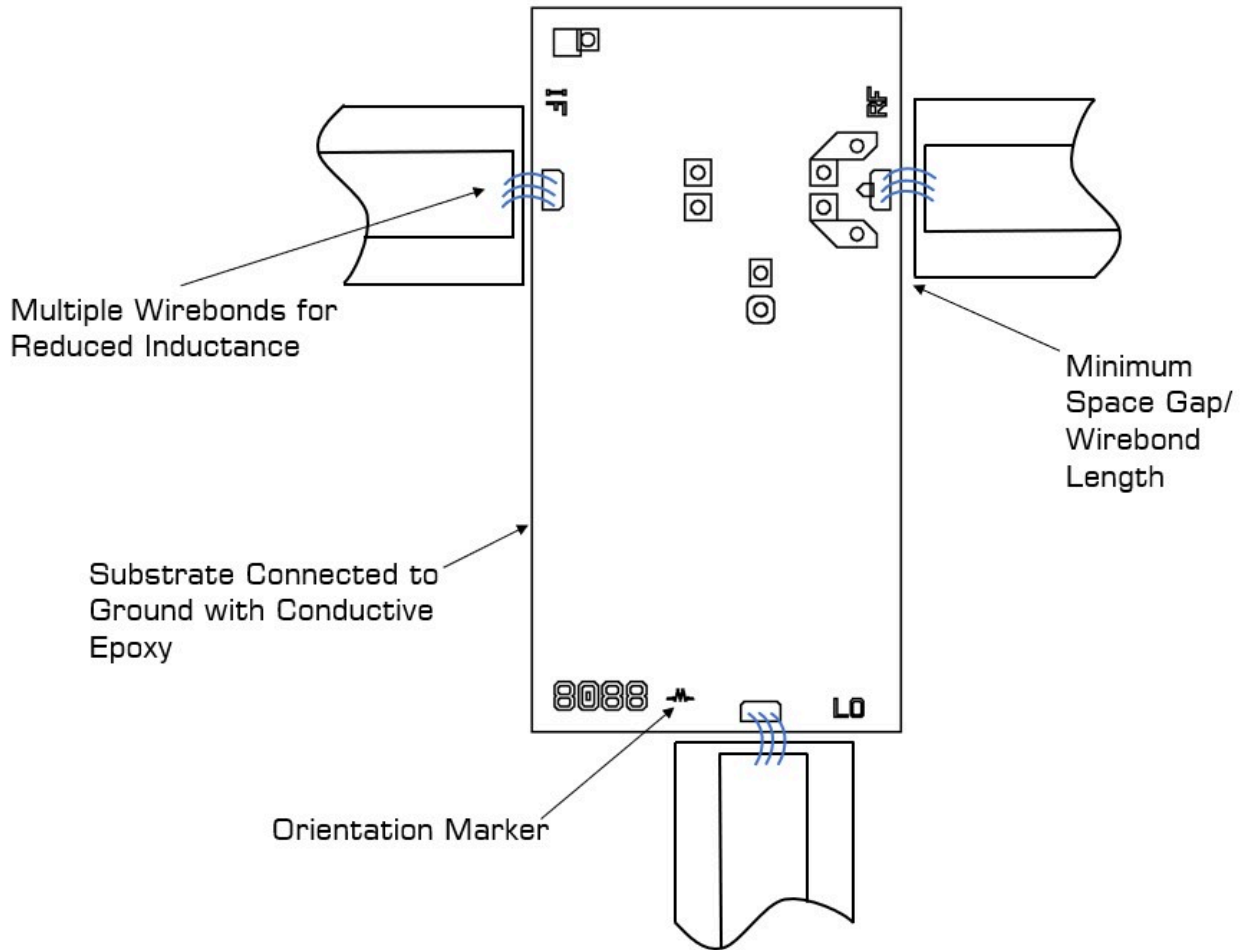
GaAs MMIC devices are sensitive to ESD and should be handled, assembled, tested, and transported only in static protected environments.

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.

MMH-35120HCH-2

GaAs MMIC Balanced mmWave Harmonic Mixer

Bonding Diagram



DISCLAIMER

MARKI MICROWAVE, INC., ("MARKI") PROVIDES TECHNICAL SPECIFICATIONS AND DATA (INCLUDING DATASHEETS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, AND OTHER INFORMATION AND RESOURCES "AS IS" AND WITH ALL FAULTS. MARKI DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT. These resources are intended for developers skilled in the art designing with Marki products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards and other requirements. Marki makes no guarantee regarding the suitability of its products for any particular purpose, nor does Marki assume any liability whatsoever arising out of your use or application of any Marki product.

Marki grants you permission to use these resources only for development of an application that uses Marki products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Marki intellectual property or to any third-party intellectual property. Marki reserves the right to make changes to the product(s) or information contained herein without notice.

MARKI MICROWAVE and T3 MIXER are trademarks or registered trademarks of Marki Microwave, Inc. All other trademarks used are the property of their respective owners.

© 2023, Marki Microwave, Inc