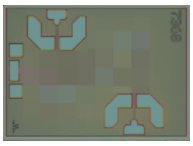
GaAs MMIC Double Balanced mmWave Mixer **MM1-35130H**

1. Device Overview



Die

1.1 General Description

MM1-35130H is a GaAs MMIC double balanced mixer that features excellent conversion loss, superior isolations, and spurious performance across an incredibly broad bandwidth. The MM1-35130H works well as both an up and down converter from the Ka band through mmWave/G band. The MM1-35130H is recommended for mmWave frequency conversion applications that require high linearity.

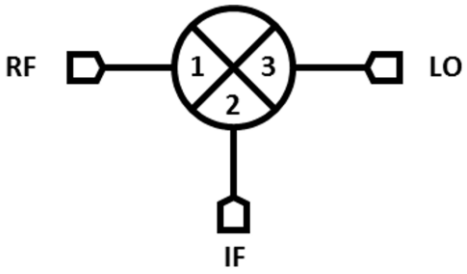
1.2 Features

- Ultra broadband, high linearity mmWave frequency conversion
- High LO to RF isolation
- Up or down conversion

1.3 Applications

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

1.4 Functional Block Diagram



1.5 Part Ordering Options[1]

Part Number	Description	Package	Green Status	Product Lifecycle	Export Classification
MM1-35130HCH-2	Wire bondable die	CH	**RoHS**	Active	EAR99

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

Table of Contents

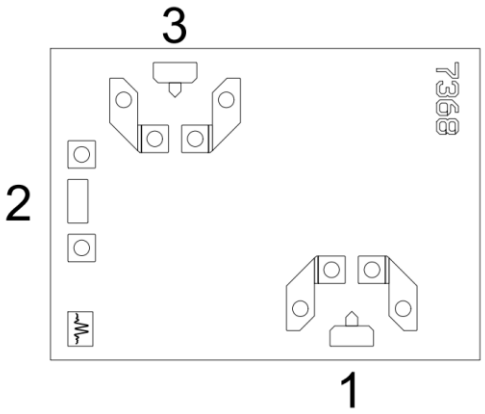
Revision History

Revision Code	Revision Date	Comment
-	May 2022	Datasheet Initial Release

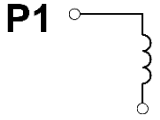
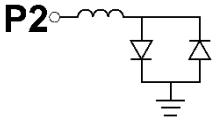
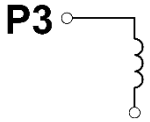
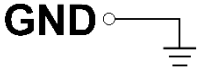
2. Port Configurations and Functions

2.1 Port Diagram

A top-down view of the MM1-35130H's CH package outline drawing is shown below. The MM1-35130H has the input and output ports given in Port Functions. The MM1-35130H can be used in either an up or down conversion. For configuration A, input the LO into port 3, use port 1 for the RF, and port 2 for the IF. For configuration B, input the LO into port 1, use port 3 for the RF, and port 2 for the IF.



2.2 Port Functions

Port	Function	Description	Equivalent Circuit for Package
Port 1	RF (Configuration A) LO (Configuration B)	Port 1 is DC open for the CH package.	
Port 2	IF	Port 2 is diode connected for the CH package.	
Port 3	LO (Configuration A) RF (Configuration B)	Port 3 is DC open for the CH package.	
GND	Ground	CH package ground path is provided through the substrate and ground bond pads.	

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
Port 1 DC Current	N/A	mA
Port 3 DC Current	N/A	mA
Power Handling, at any Port	+30	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

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
LO Input Power	+12	+14		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 mixer that requires no DC bias.

3.5 Electrical Specifications

The electrical specifications apply at T_A=+25°C in a 50Ω system. Typical data shown is for the connectorized M package mixer used in the forward direction with a sine wave LO input.[2] Specifications shown for configuration A.

Min and Max limits apply only to our connectorized units and are guaranteed at T_A=+25°C. All bare die are 100% DC tested and visually inspected.

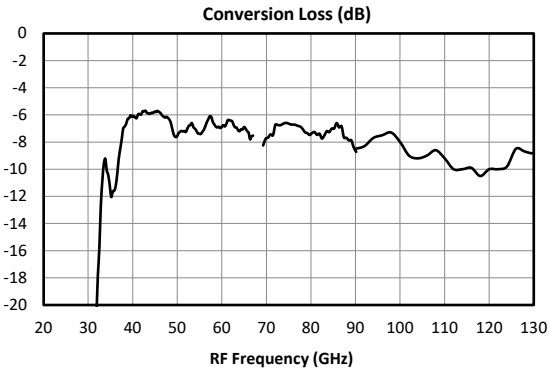
Parameter	Test Conditions	Min	Typical	Max	Units
RF (Port 3) Frequency Range		35		130	GHz
LO (Port 1) Frequency Range		35		130	
I (Port 2) Frequency Range		0		50	
Conversion Loss (CL)[3]	RF/LO = 35 - 130 GHz I = DC - 0.2 GHz		8		dB
Noise Figure (NF)[4]	RF/LO = 35 - 130 GHz I = DC - 0.2 GHz		8		dB

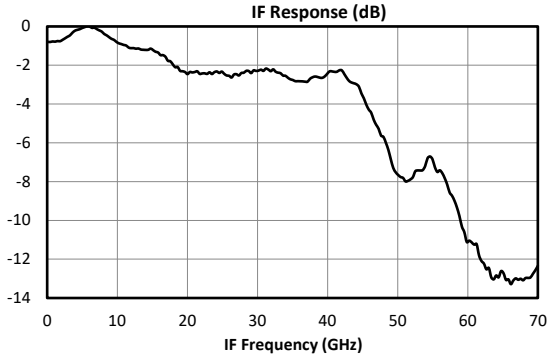
[2] LO power used for characterization varies by band. Saturated amplifiers used were AMM-6702, and A-3567

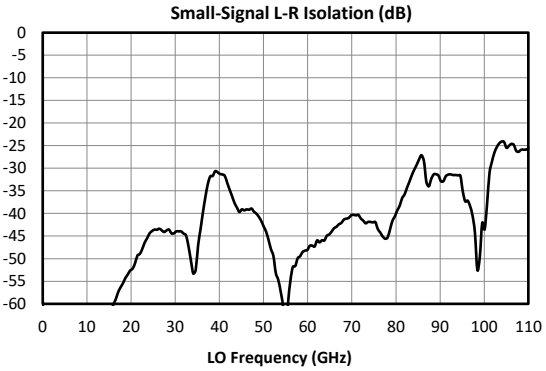
[3] Measured as a down converter to a fixed 91MHz IF.

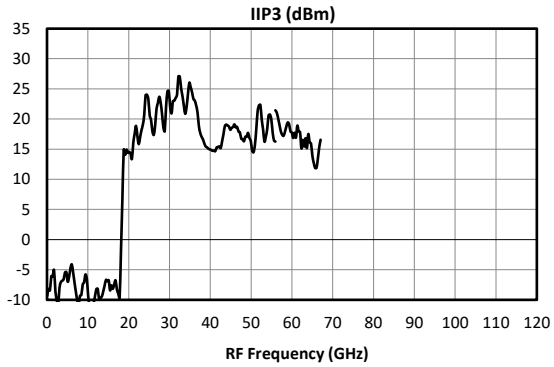
[4] Mixer Noise Figure typically measures within 0.5 dB of conversion loss for IF frequencies greater than 5 MHz.

4. Typical Performance Plots[5]









[5] Due to difficulty generating strong LO signals at mmWave frequencies LR Isolation is measured with a small signal LO. Isolation will improve with a stronger LO signal. Discontinuity in conversion loss measurement is due to splitting the measurement into multiple bands. IIP3 is only measured up to 67GHz due to limitations in measurement setup. Conversion loss will extend to 135GHz with sufficient LO drive.

5. Die Mounting Recommendations

5.1 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.

5.2 Handling Precautions

General Handling

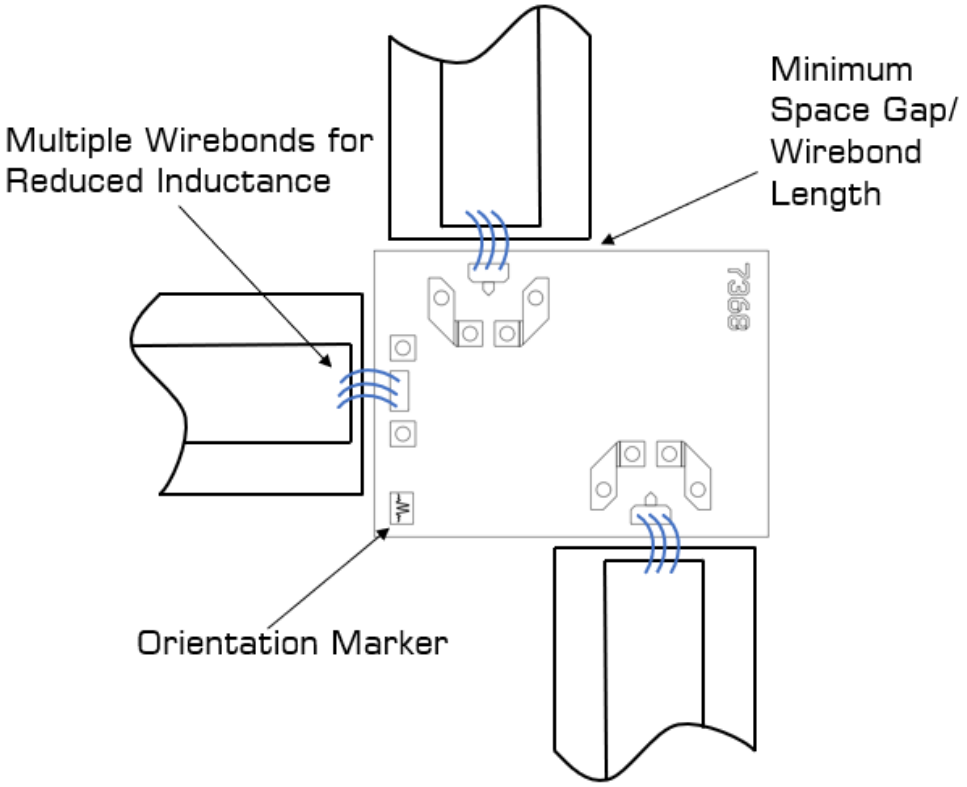
Chips should be handled with care using tweezers or a vacuum collet. Users should take precautions to protect chips from direct human contact that can deposit contaminants, like perspiration and skin oils on any of the chip's surfaces.

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.

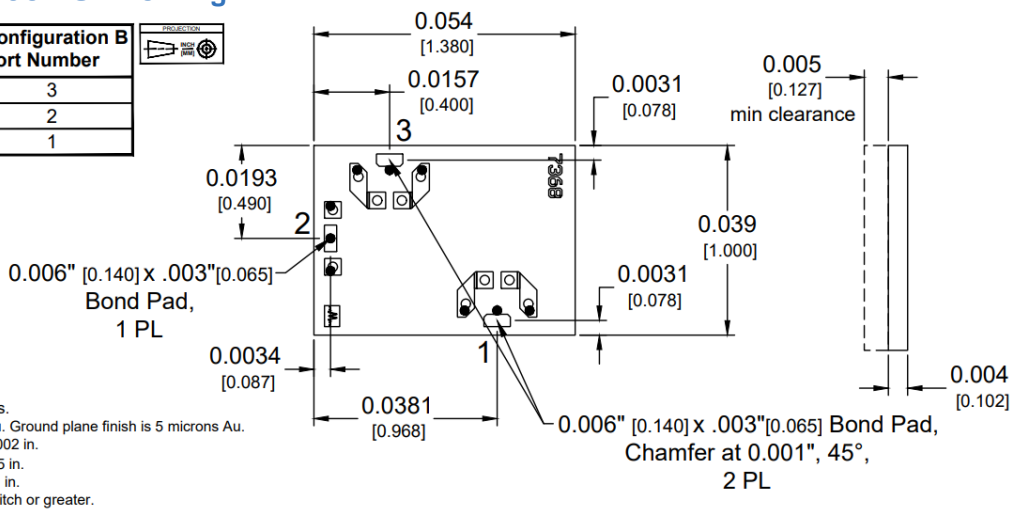
5.3 Bonding Diagram



6. Mechanical Data

6.1 CH Package Outline Drawing

Function	Configuration A Port Number	Configuration B Port Number
RF	1	3
IF	2	2
LO	3	1



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. Compatible with RF probes 150 um pitch or greater.
5. Drop RF probes on the highlighted region of the RF/IF/LO bondpads for connection to the circuit. This will not present the same electrical results as designed, but serves to confirm mixer operation.
6. Designed PCB transition is a 125 um thick RO5880 microstrip ribbon bonded to the bondpad. Ribbon bond has a 50 um loop height.
   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 bondpads.
   d. All GND bondpads have passivation removed and are therefore bondable for CPW PCB transitions. No reference design available.