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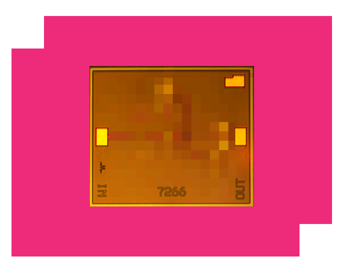
MMD-20100HCH

GaAs MMIC Millimeter Wave Doubler

DEVICE OVERVIEW

General Description

MMD-20100H is a MMIC millimeter wave 2x multiplier fabricated with GaAs Schottky diodes. MMD-20100H operates over a 10 to 50 GHz input frequency range or a doubled output frequency range of 20 to 100 GHz. MMD-20100H is available as a connectorized coaxial module using 1.0 mm connectors on the output. Wire bondable die are also available.



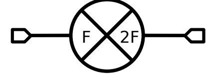
Features

- Low input power requirement
- Low loss die and package
- Up to 100GHz 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	Connectors	Green Status	Product Lifecycle	Export Classification
MMD-20100HM	GaAs MMIC Millimeter Wave Doubler	M	Standard	REACH RoHS	Released	EAR99
MMD-20100HCH	GaAs MMIC Millimeter Wave Doubler	CH	-	REACH RoHS	Released	EAR99

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Revision History

Revision Code	Revision Date	Comment
-	2020-10-01	Initial Datasheet Release
A	2024-03-14	Export Classification Update

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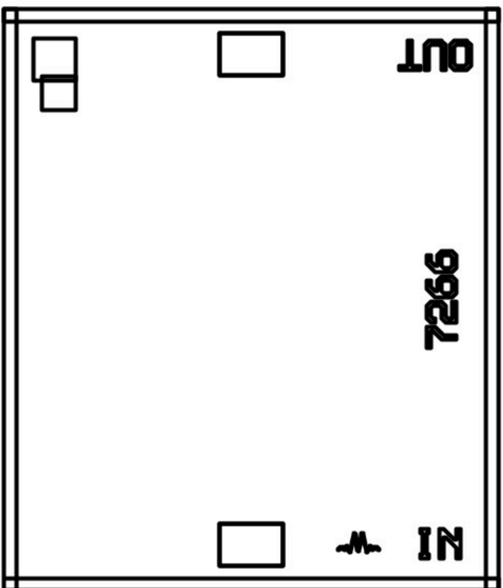
Port Configuration and Functions

Port Diagram

A top-down view of the MMD-20100H's CH package outline drawing is shown below. The MMD-20100H should only be used in the forward direction, with the input and output ports given in Port Functions.



Port Functions

Port	Function	Description	DC Equivalent Circuit
GND	Ground	CH package ground path is provided through the substrate and ground bond pads.	
Port 1	Input	Input 1x Frequency Port. Port 1 is DC coupled to the diodes for the CH packages. Blocking capacitor is optional.	
Port 2	Output	2x Input Frequency output port. Port 2 is DC open for the CH 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 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	-	1.17 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
Ambient Temperature	-55	25	100	°C
Input Power	-	10	15	dBm

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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 +10 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	70	90	-	13	-	dB
Conversion Loss	Second Harmonic Output	20	25	-	13	-	dB
Conversion Loss	Second Harmonic Output	90	100	-	16	-	dB
Conversion Loss	Second Harmonic Output	25	70	-	10	13	dB
Input Frequency Range	-	-	-	10	-	50	GHz
Input Power	-	-	-	-	10	15	dBm
Isolation, 1F [1]	Input = 10 – 50 GHz Output = 10 – 50 GHz	10	50	-	36	-	dB
Isolation, 3F [2]	Input = 10 – 33.3 GHz Output = 30 – 100 GHz	30	100	-	44	-	dB
Isolation, 4F [3]	Input = 10 – 25 GHz Output = 40 – 100 GHz	40	100	-	25.5	-	dB
Output Frequency Range [4]	-	-	-	20	-	100	GHz
Suppression, 1F [5]	Input = 10 – 50 GHz Output = 10 – 50 GHz	10	50	-	24.5	-	dBc
Suppression, 3F [6]	Input = 10 – 33.3 GHz Output = 30 – 100 GHz	30	100	-	33	-	dBc
Suppression, 4F [7]	Input = 10 – 25 GHz Output = 40 – 100 GHz	40	100	-	14	-	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 17.2 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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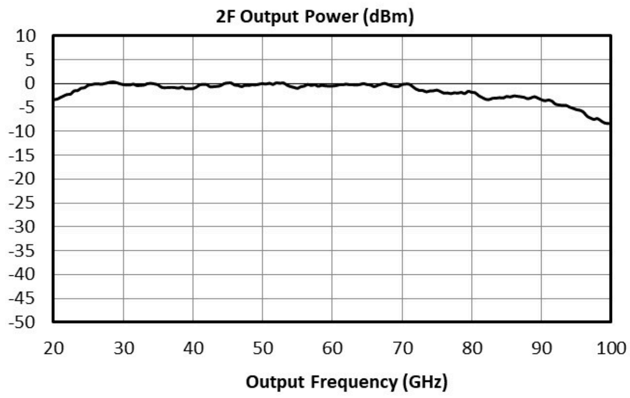
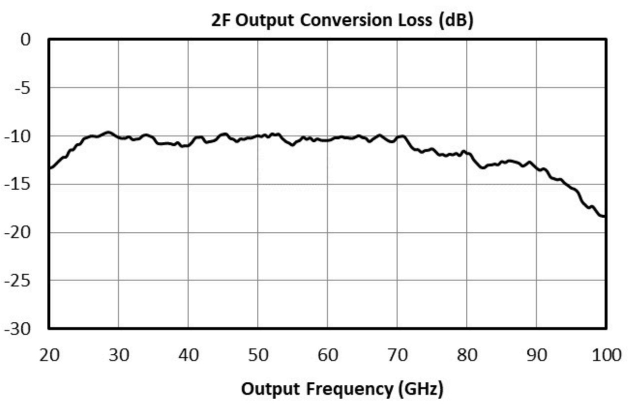
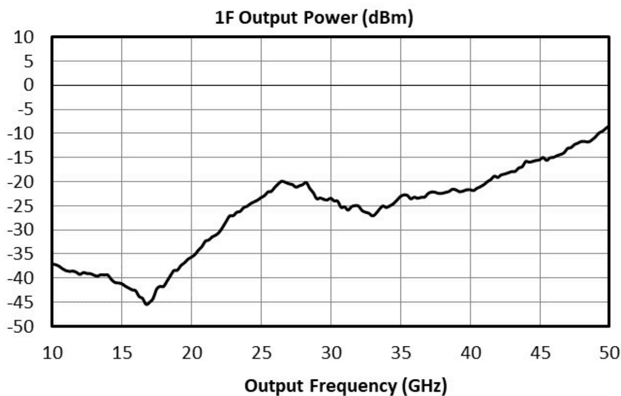
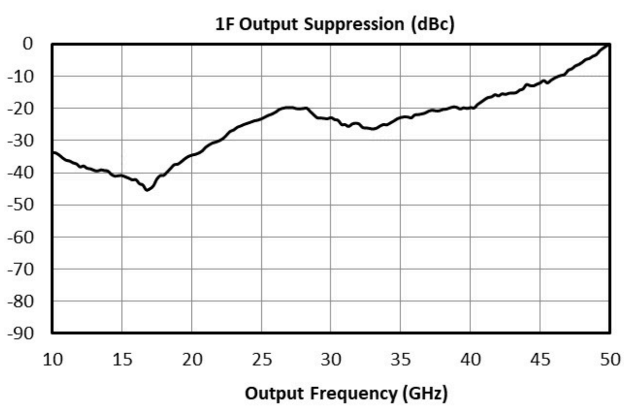
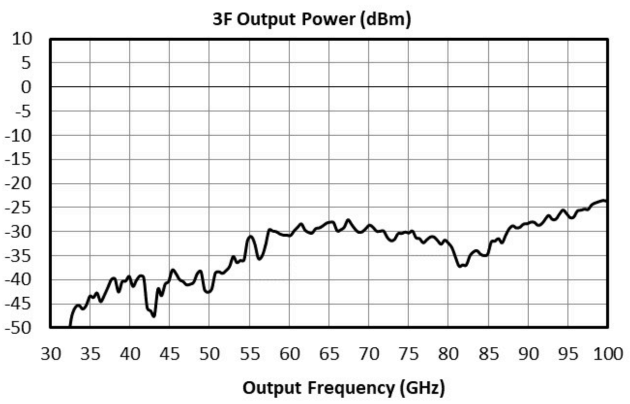
Typical Performance Plots

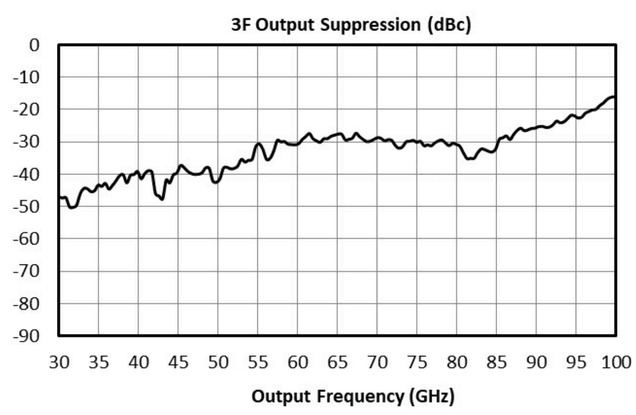


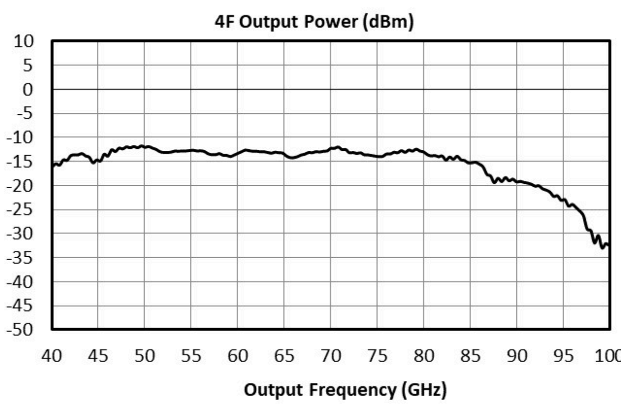


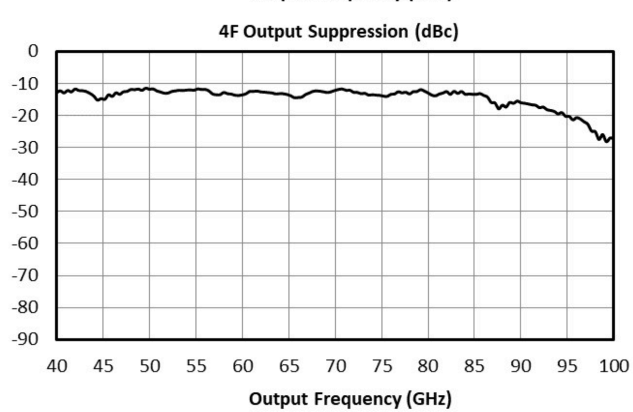












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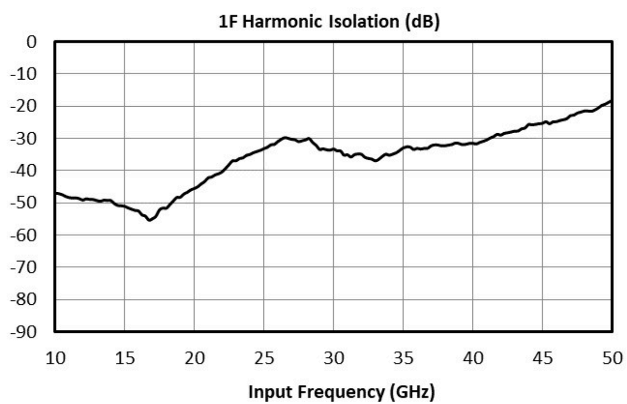
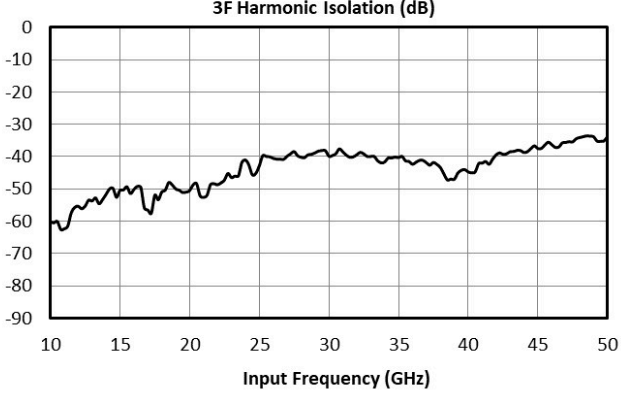
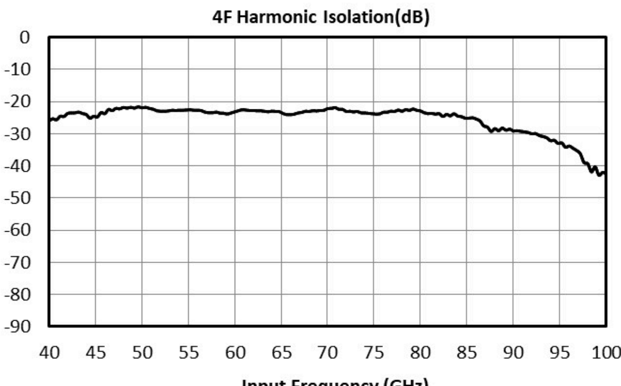


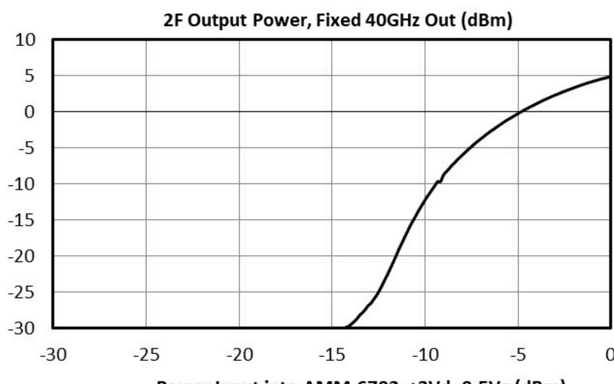
1F Harmonic Isolation (dB)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
10
15
20
25
30
35
40
45
50
Input Frequency (GHz)



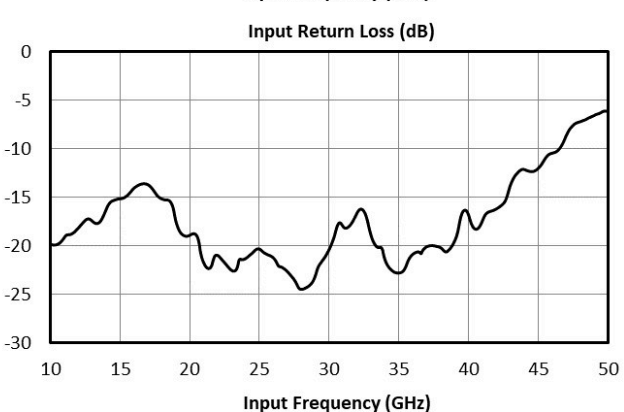
3F Harmonic Isolation (dB)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
10
15
20
25
30
35
40
45
50
Input Frequency (GHz)



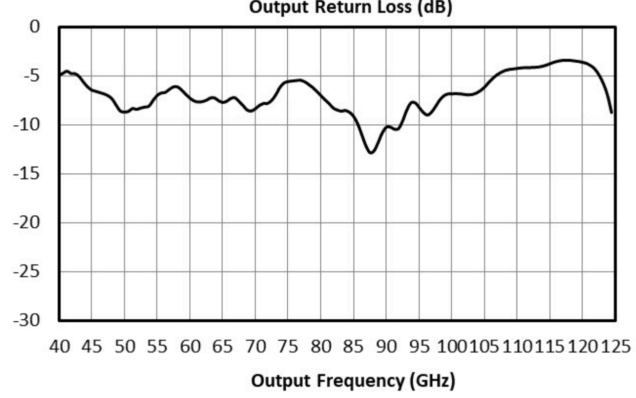
4F Harmonic Isolation(dB)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
40
45
50
55
60
65
70
75
80
85
90
95
100
Input Frequency (GHz)



2F Output Power, Fixed 40GHz Out (dBm)
10
5
0
-5
-10
-15
-20
-25
-30
-30
-25
-20
-15
-10
-5
0
Power Input into AMM-6702, +3Vd -0.5Vg (dBm)



Input Return Loss (dB)
0
-5
-10
-15
-20
-25
-30
10
15
20
25
30
35
40
45
50
Input Frequency (GHz)



Output Return Loss (dB)
0
-5
-10
-15
-20
-25
-30
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125
Output Frequency (GHz)

MMD-20100HM - 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.

2F Output Power (dBm)

Output Frequency (GHz)

2F Output Conversion Loss (dB)

Output Frequency (GHz)

1F Output Power (dBm)

Output Frequency (GHz)

1F Output Suppression (dBc)

Output Frequency (GHz)

3F Output Power (dBm)

Output Frequency (GHz)

3F Output Suppression (dBc)

Output Frequency (GHz)

4F Output Power (dBm)

Output Frequency (GHz)

4F Output Suppression (dBc)

Output Frequency (GHz)

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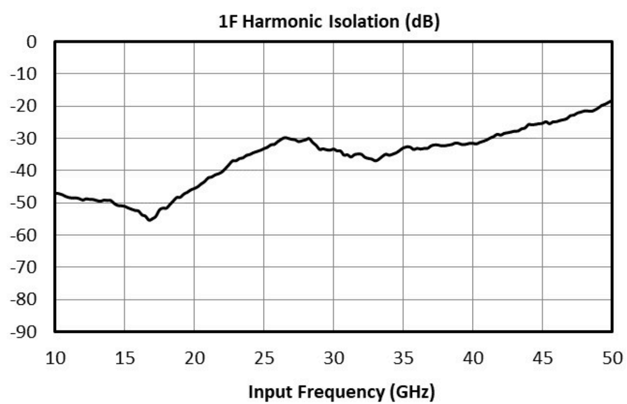

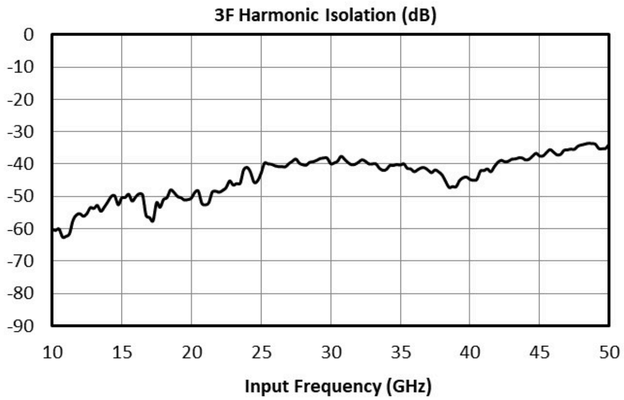

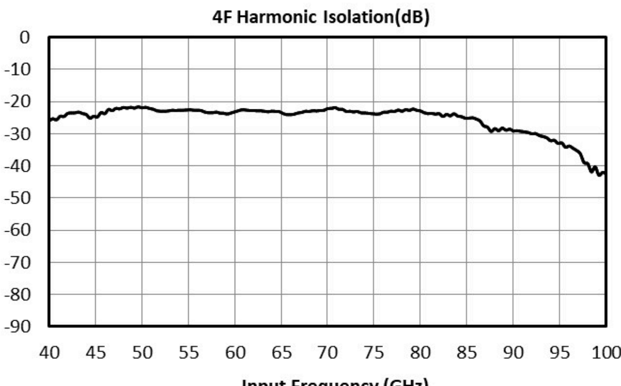

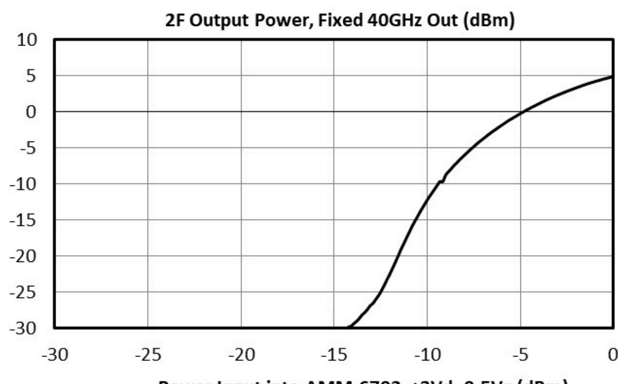

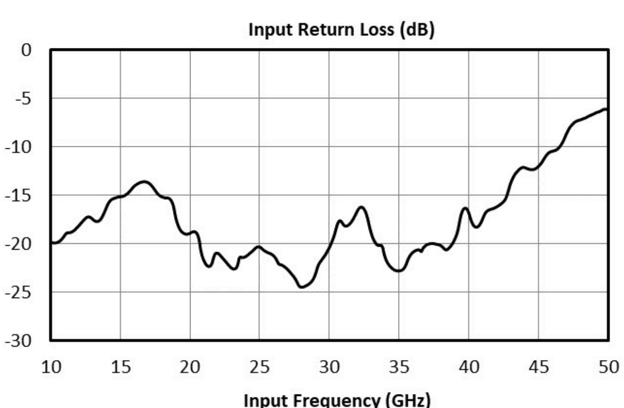

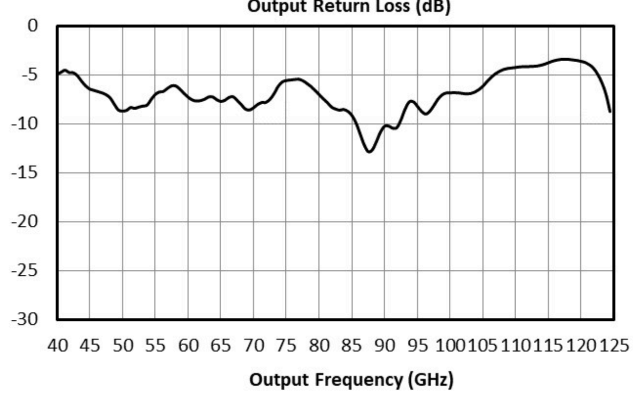

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Die Mounting Recommendations

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.

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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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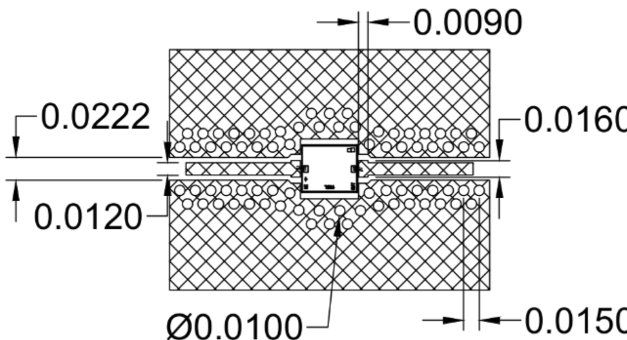
Bonding Diagram



Notes: (Unless otherwise specified)

1. Units in inch
2. Front to back registration to be .002 max.
3. Shaded areas in this drawing are metalized.
4. Substrate is Rogers 5880, 0.005 in thick, $\frac{1}{2}$ oz Cu
5. Finish: ENIG, 100μ-inches of Gold type III Grade A Soft Gold for Wire Bonding over 100-200 μ-inches solderable Nickel.

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Mechanical Data

Outline Drawing

Download : Outline 2D Drawing

PROJECTION	REVISIONS			
INCH [MM]	REV.	DESCRIPTION	DATE	APPROVALS
	A	ECN 24096 remove gel-pak info.	10/18/24	AT

.004[.100] x.004[.100]
Ground pad

.023
[.585]

.005
[.13]
min clearance

.004
[.107]

OUT

7266

.054
[1.380]

IN

.046
[1.170]

.006[.150] x.004[.100]
bonding pad, 2 PL

.004
[.10]

Notes:

1. CH substrate is .004 in Thick GaAs.
2. I/O traces finish is 4.2 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.

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UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: HOLE SIZE / DECIMALS .XX± .01 .XXX± .002 / ANGLES ± / 63	NOTES:		Marki microwave www.markimicrowave.com		
	DRAWN BY	DATE	Outline MMIC Doubler		
MATERIAL: 210-07266-R70	JL	09/29/20			
FINISH:			SIZE A	CAGE CODE 0UC32	DWG. NO. MMD-20100HCH
DO NOT SCALE DRAWING			SCALE 40/1		SHEET 1 OF 1

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