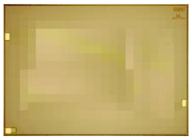
Passive GaAs MMIC Bandpass Filter Family **MFBC-000XXCH**

1 Device Overview



Die

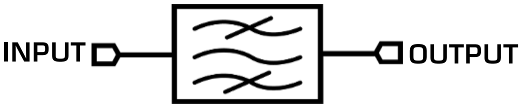
1.1 General Description

The MFBC-000XXCH family of passive MMIC bandpass filters are an ideal solution for small form factor, mmWave, high rejection filtering. Passive GaAs MMIC technology allows production of smaller filter constructions that replace larger form factor circuit board constructions. Tight fabrication tolerances allow for less unit-to-unit variation than traditional filter technologies. Low unit-to-unit variation allows for accurate simulations using the provided S2P file taken from measured production units. The MFBC-000XXCH is available as a wire bondable die.

1.2 Features

- Excellent Return Loss
- High Stop Band Suppression
- Wide Stop Band with Fast Roll-Off
- S2P data available

1.3 Functional Block Diagram



1.4 Part Ordering Options[1]

Part Number	1dBc Passband (GHz)	Description	Package	Green Status	Product Lifecycle	Export Classification
MFBC-00008CH	36.70 – 51.10	Wire bondable die	CH	RoHS	Active	EAR99
MFBC-00009CH	46.50 – 63.50					
MFBC-00017CH	34.50 – 49.50					
MFBC-00018CH	44.50 – 62.50					
MFBC-00019CH	58.30 – 77.70					
MFBC-00020CH	77.35 – 107.80					

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

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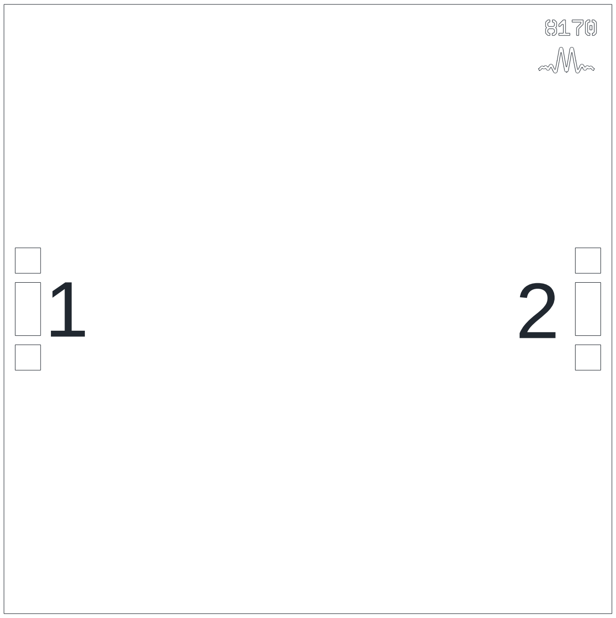
Revision History

Revision Code	Revision Date	Comment
-	March 2023	Datasheet Initial Release

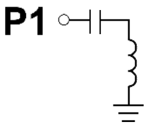
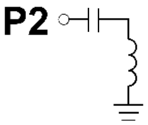
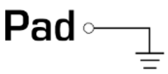
2 Port Configurations and Functions

2.1 Port Diagram

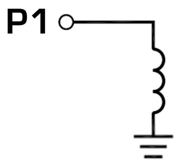
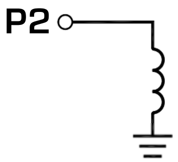
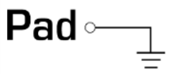
A top-down view of the MFBC-00008CH’s CH package outline drawing is shown below. For all other MFBC-000XXCH outline drawings, refer to Section 5 Mechanical Data. The MMIC bandpass filters are symmetrical allowing Port 1 or Port 2 to be used as the input.



2.2 MFBC-00008/9/19/20CH Port Functions

Port	Function	Description	Equivalent Circuit
Port 1	Input/Output	Port 1 is DC open to ground for the CH package.	
Port 2	Input/Output	Port 2 is DC open to ground for the CH package.	
Pad	Ground	CH package ground path is provided through the substrate and ground bond pads.	

2.3 MFBC-00017/18CH Port Functions

Port	Function	Description	Equivalent Circuit
Port 1	Input/Output	Port 1 is DC short to ground for the CH package.	
Port 2	Input/Output	Port 2 is DC short to ground for the CH package.	
Pad	Ground	CH package ground path is provided through the substrate and ground bond pads.	

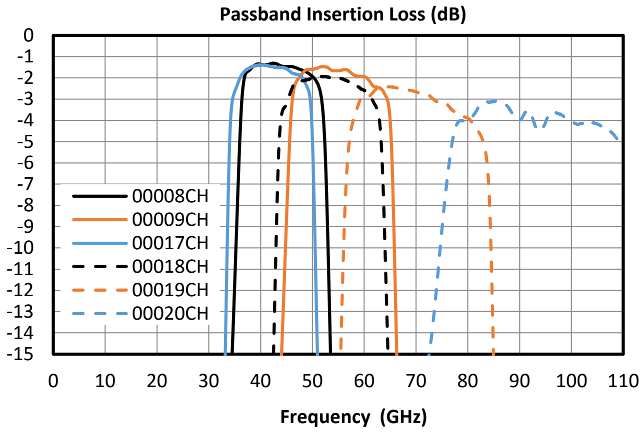
3 Specifications

3.1 Absolute Maximum Ratings

The Absolute Maximum Ratings indicate limits beyond which damage may occur to the device. If these limits are exceeded or met simultaneously, the device may be inoperable or have a reduced lifetime.

Parameter	MFBC-00017/18CH Maximum Rating	MFBC-00008/09/19/20CH Maximum Rating	Units
Port 1 DC Current	400	N/A	mA
Port 2 DC Current	400	N/A	mA
Operating Temperature	-55 to +100	-55 to +100	°C
Storage Temperature	-65 to +125	-65 to +125	ºC

3.2 Passband Comparison



Part Number	1dBc Cutoff Low (GHz)	1dBc Cutoff High (GHz)
MFBC-00008CH	36.70	51.10
MFBC-00009CH	46.50	63.50
MFBC-00017CH	34.50	49.50
MFBC-00018CH	44.50	62.50
MFBC-00019CH	58.30	77.70
MFBC-00020CH	77.35	107.80

3.3 Electrical Specifications

The electrical specifications apply at T_A=+25°C in a 50Ω system. Typical data for all filters is shown with a sine wave input applied to port 1.

Min and Max limits are guaranteed at T_A=+25°C. All bare die are 100% DC tested and visually inspected.

3.3.1 MFBC-000XXCH

MFBC-00008CH	Frequency (GHz)	Min	Typ.	Max
Center Frequency, f_c (GHz)			44.50	
1dBc Passband (GHz)			36.70 – 51.10	
3dBc Passband (GHz)			36.20 – 52.10	
Insertion Loss @ f_c (dB)	44.50		1.50	
Passband Return Loss (dB)	36.70 – 51.10		15	
Stopband Suppression (dB)	DC – 23.00	40	64	
	62.00 – 67.00	40	45	
Group Delay (ps)			140	
Impedance (Ω)			50	

MFBC-00009CH	Frequency (GHz)	Min	Typ.	Max
Center Frequency, f_c (GHz)			55.60	
1dBc Passband (GHz)			46.50 – 63.50	
3dBc Passband (GHz)			45.80 – 64.90	
Insertion Loss @ f_c (dB)	55.60		1.60	
Passband Return Loss (dB)	46.50 – 63.50		15	
Stopband Suppression (dB)	DC – 29.50	40	67	
Group Delay (ps)			115	
Impedance (Ω)			50	

MFBC-00017CH	**Frequency (GHz)**	**Min**	**Typ.**	**Max**
Center Frequency, f_c (GHz)			42.00	
1dBc Passband (GHz)			34.50 – 49.50	
3dBc Passband (GHz)			34.00 – 50.00	
Insertion Loss @ f_c (dB)	42.00		1.50	
Passband Return Loss (dB)	34.50 – 49.50		12	
Stopband Suppression (dB)	DC – 30.50	30	51	
	54.50 – 67.00	30	47	
Group Delay (ps)			156	
Impedance (Ω)			50	

MFBC-00018CH	**Frequency (GHz)**	**Min**	**Typ.**	**Max**
Center Frequency, f_c (GHz)			53.75	
1dBc Passband (GHz)			44.50 – 62.50	
3dBc Passband (GHz)			43.50 – 63.50	
Insertion Loss @ f_c (dB)	53.75		2.00	
Passband Return Loss (dB)	44.50 – 62.50		10	
Stopband Suppression (dB)	DC – 40.00	30	52	
Group Delay (ps)			138	
Impedance (Ω)			50	

3.3.2 MFBC-00019/20M

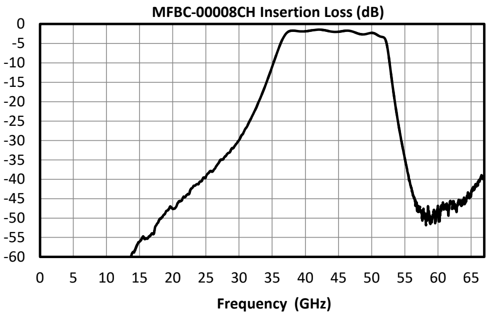
Due to measurement limitations of the characterization test setup, performance for the MFBC-00019CH and MFBC-00020CH were measured for their connectorized M-package variants: MFBC-00019M and MFBC-00020M. For the CH die filters, the insertion loss would be expected to improve by approximately 0.5 dB from the data shown below. Improvements may be also seen in rejection steepness and group delay.

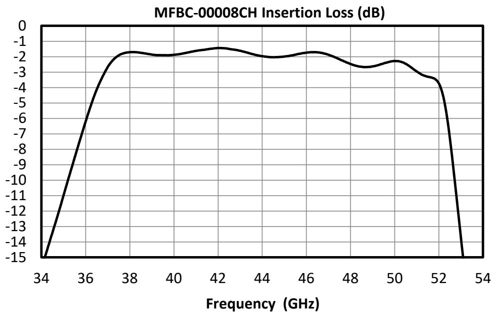
MFBC-00019M	**Frequency (GHz)**	**Min**	**Typ.**	**Max**
Center Frequency, f_c (GHz)			70.00	
1dBc Passband (GHz)			58.30 – 77.70	
3dBc Passband (GHz)			56.90 – 83.50	
Insertion Loss @ f_c (dB)	70.00		2.85	
Passband Return Loss (dB)	58.30 – 77.70		13	
Stopband Suppression (dB)	DC – 52.00	30	58	
	89.00 to 110.00	30	42	
Group Delay (ps)			225	
Impedance (Ω)			50	

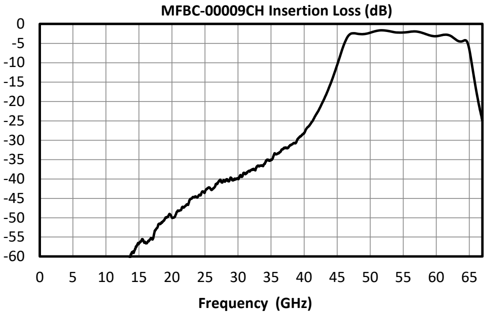
MFBC-00020M	**Frequency (GHz)**	**Min**	**Typ.**	**Max**
Center Frequency, f_c (GHz)			93.50	
1dBc Passband (GHz)			77.35 – 107.80	
3dBc Passband (GHz)			76.10 – 112.00	
Insertion Loss @ f_c (dB)	93.50		3.60	
Passband Return Loss (dB)	77.35 – 107.80		10	
Stopband Suppression (dB)	DC – 63.00	30	52	
Group Delay (ps)			198	
Impedance (Ω)			50	

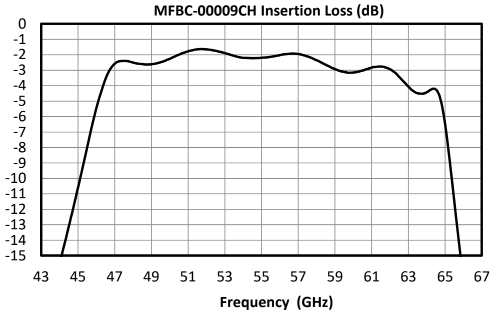
3.4 Typical Performance Plots

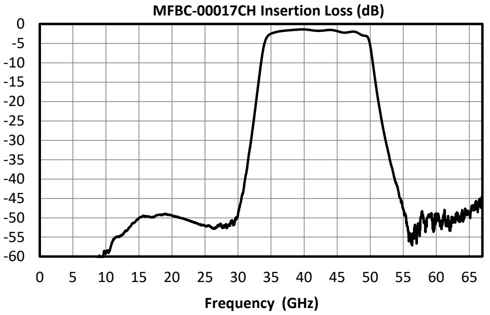
3.4.1 MFBC-000XXCH Insertion Loss

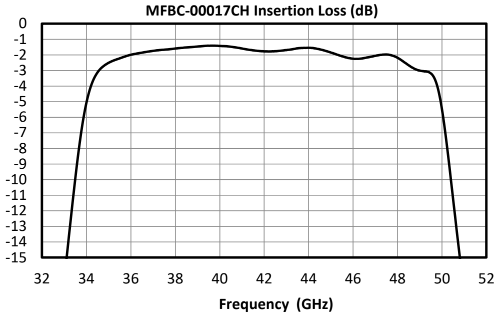


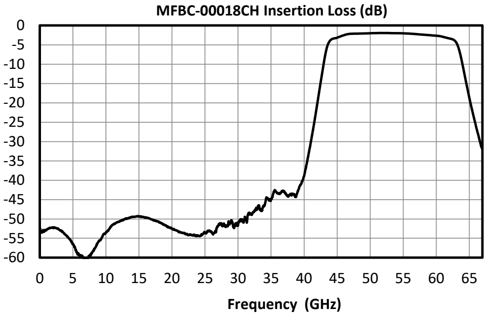


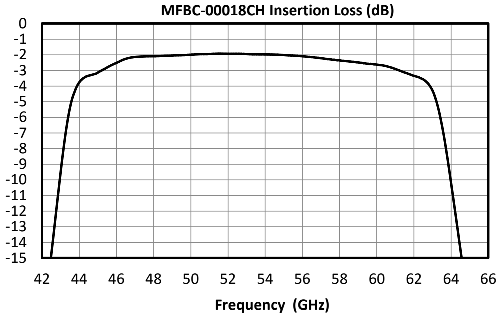




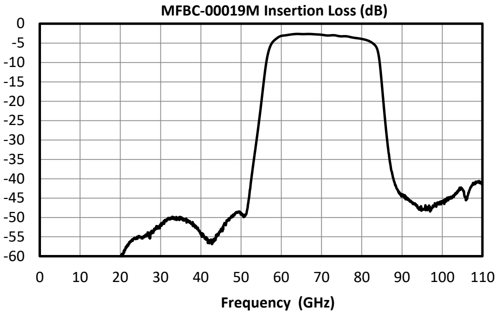


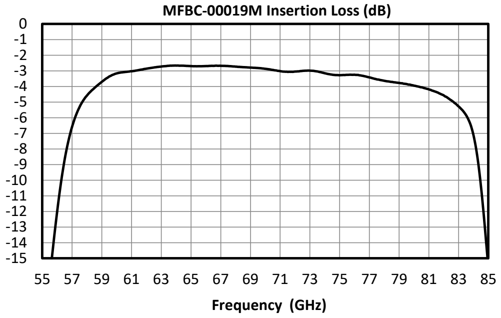


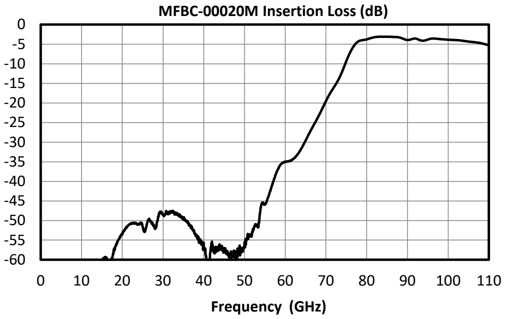


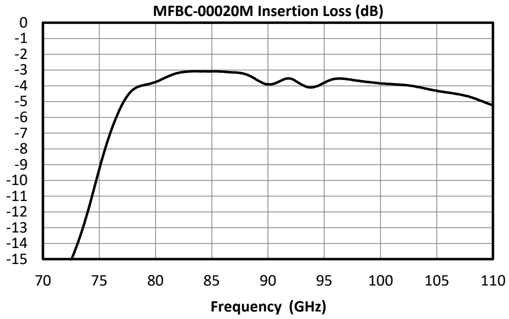


3.4.2 MFBC-00019/20M Insertion Loss

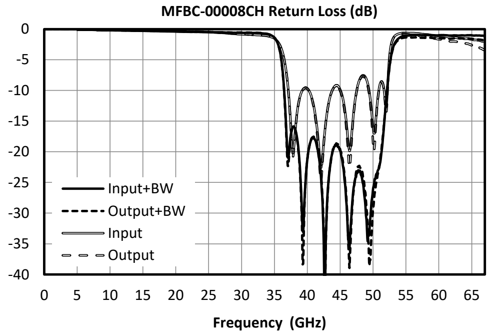

MFBC-00019M Insertion Loss (dB)

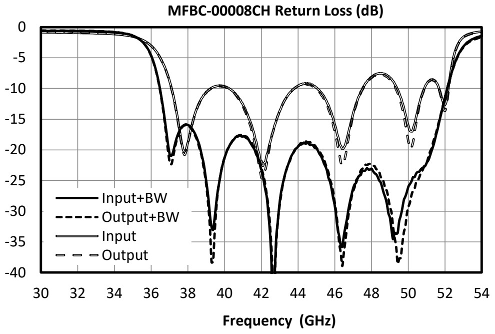

MFBC-00019M Insertion Loss (dB)

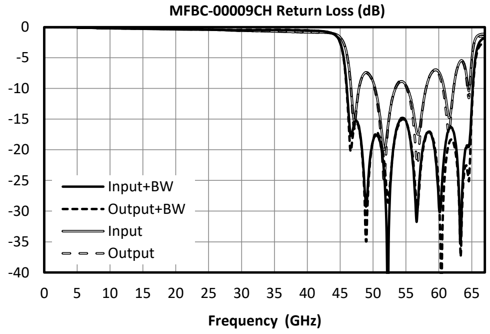

MFBC-00020M Insertion Loss (dB)

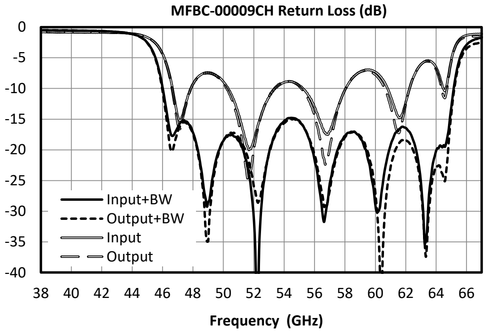

MFBC-00020M Insertion Loss (dB)

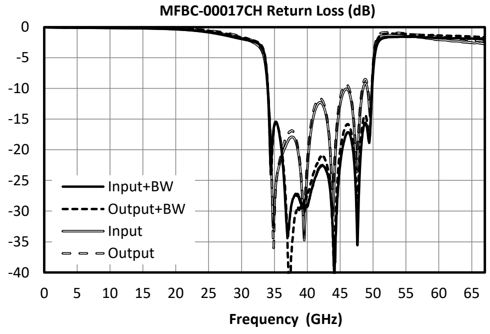
3.4.3 MFBC-000XXCH Return Loss[2]

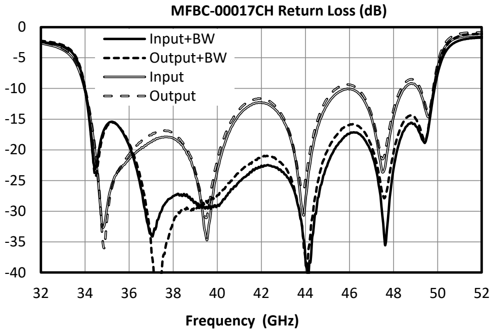

MFBC-00008CH Return Loss (dB)

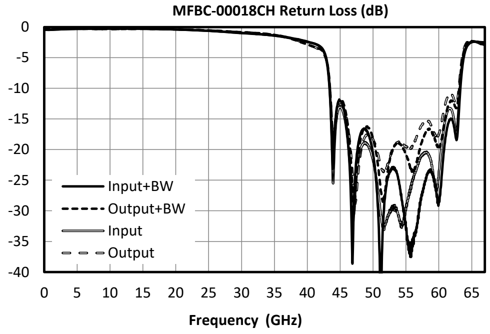

MFBC-00008CH Return Loss (dB)

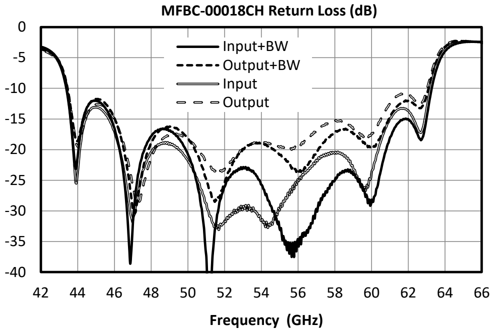

MFBC-00009CH Return Loss (dB)


MFBC-00009CH Return Loss (dB)


MFBC-00017CH Return Loss (dB)


MFBC-00017CH Return Loss (dB)


MFBC-00018CH Return Loss (dB)


MFBC-00018CH Return Loss (dB)

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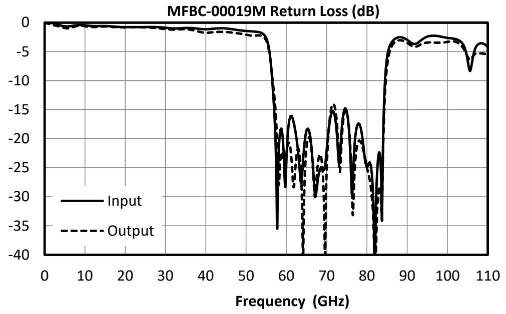
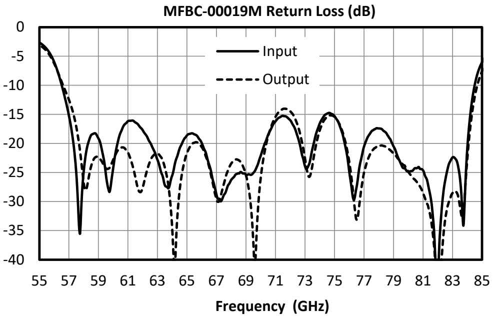
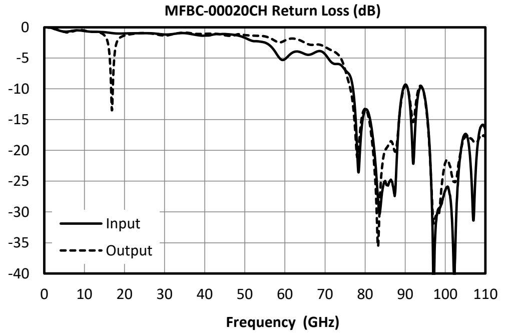
[2] To show performance improvement with bond wires (BW), inductance was added to these measurements in simulation per the table on the page 12.

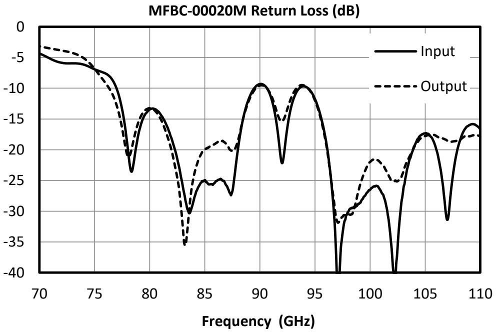
Filter Name	Number of Bondwires	Bondwire Length (um)	Bondwire Diameter (mil)	Bondwire Inductance (pH)
MFBC-00008CH	2	400	1	128
MFBC-00009CH	2	400	1	132
MFBC-00017CH	2	275	1	74
MFBC-00018CH	3	275	1	30

3.4.4 MFBC-00019/20M Return Loss[3]









Filter Name	Number of Bondwires	Bondwire Length (um)	Bondwire Diameter (mil)	Bondwire Inductance (pH)
MFBC-00019M	3	250	1	30
MFBC-00020M	3	250	1	30

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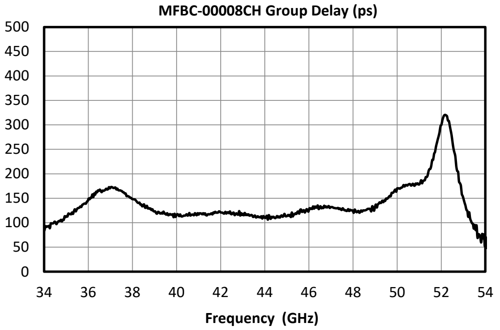
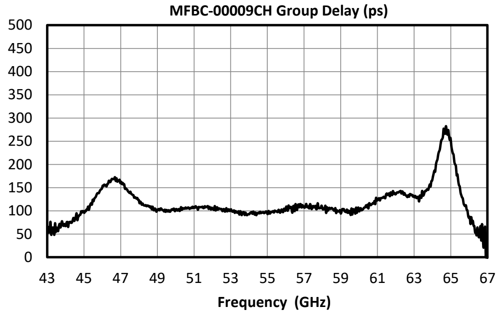
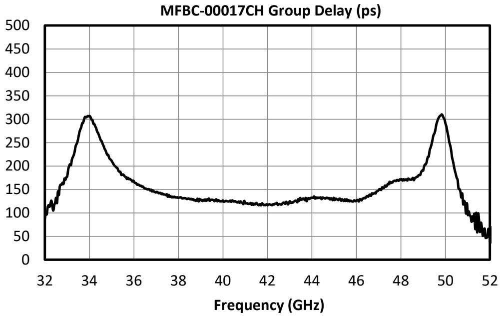
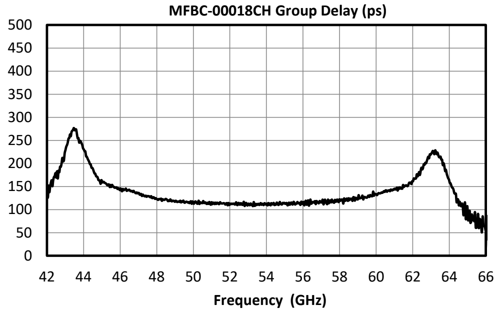
[3] The bond wire (BW) specifications for this section refer to bond wires used in the M package filters.

3.4.5 MFBC-000XXCH Group Delay

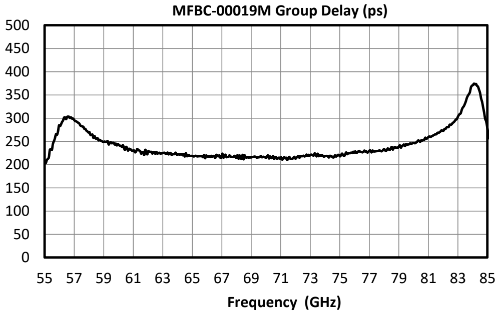


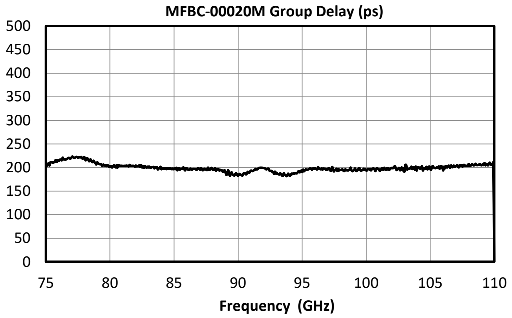






3.4.6 MFBC-00019/20M Group Delay





4 Die Mounting Recommendations

4.1 Mounting and Bonding Recommendations

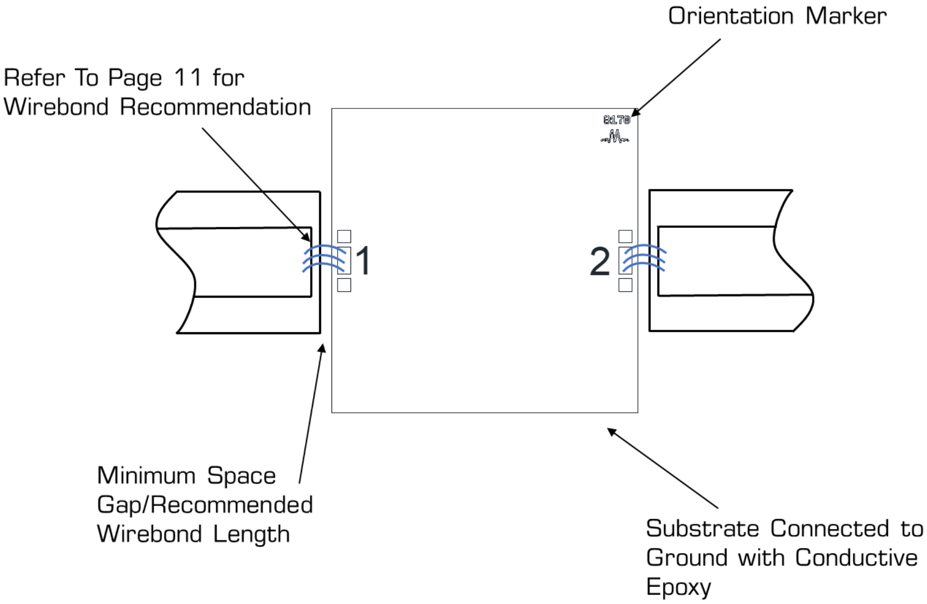
Marki MMICs should be attached directly to a ground plane with conductive epoxy. The ground plane electrical impedance should be as low as practically possible. This will prevent resonances and permit the best possible electrical performance. Datasheet performance is only guaranteed in an environment 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. Bond wire inductance will improve return loss. Bondwire inductance in the range of 30pH to 200pH will improve performance.

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. Refer to table on page 11 for wirebond recommendation. In circumstances where the chip is more than .001" thinner than the substrate, a heat spreading spacer tab is optional to further reduce bondwire length and parasitic inductance.

4.2 Bonding Diagram



4.3 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

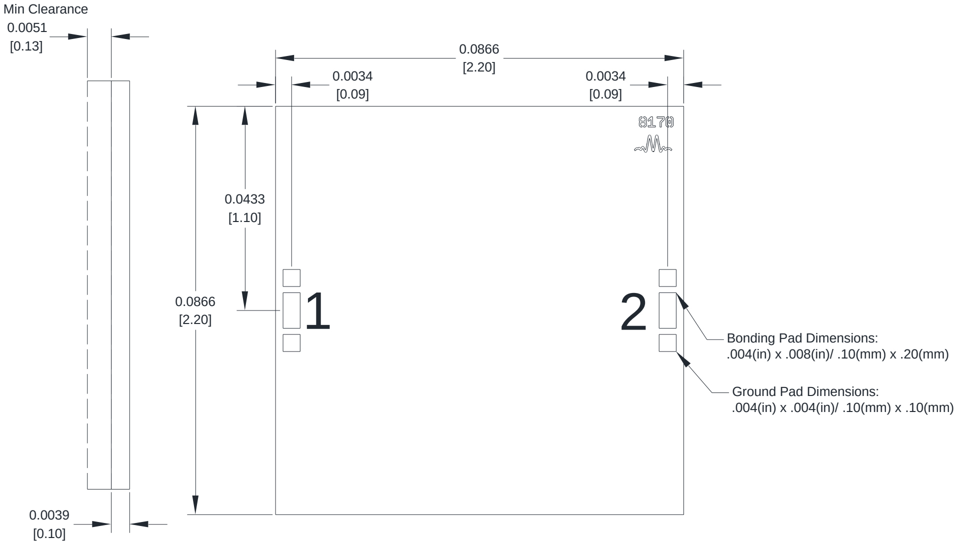
GaAs MMIC devices are sensitive to ESD and should be handled, assembled, tested, and transported only in static protected environments.

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.

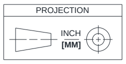
5 Mechanical Data

5.1 CH Package Outline Drawing

MFBC-00008/9/17CH



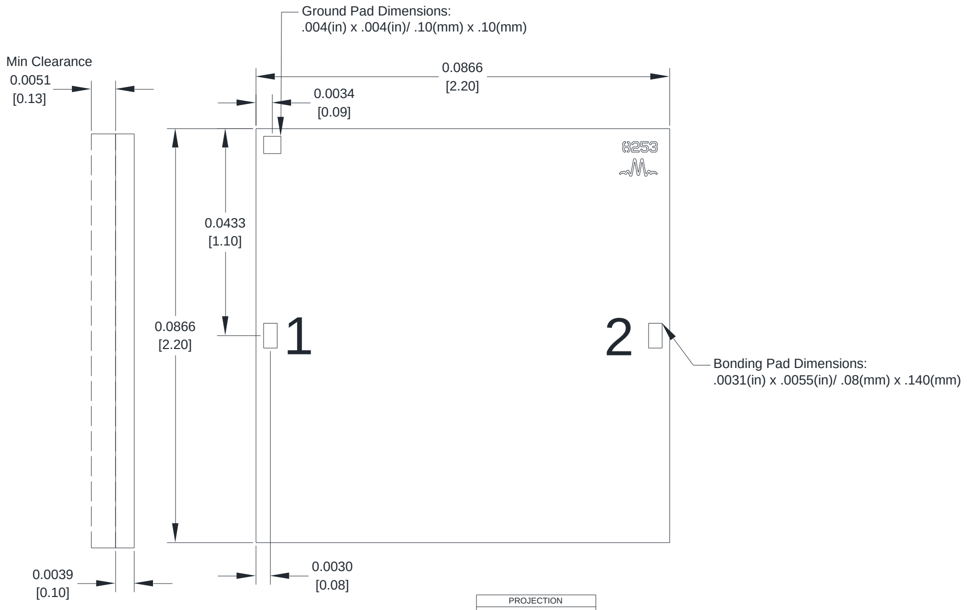
Notes:



1. CH substrate is .004 Thick GaAs.
2. I/O trace is 5 microns Au. Ground is 4 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.

Part Number	Die Number
MFBC-00008CH	8170
MFBC-00009CH	8171
MFBC-00017CH	8252

MFBC-00018CH

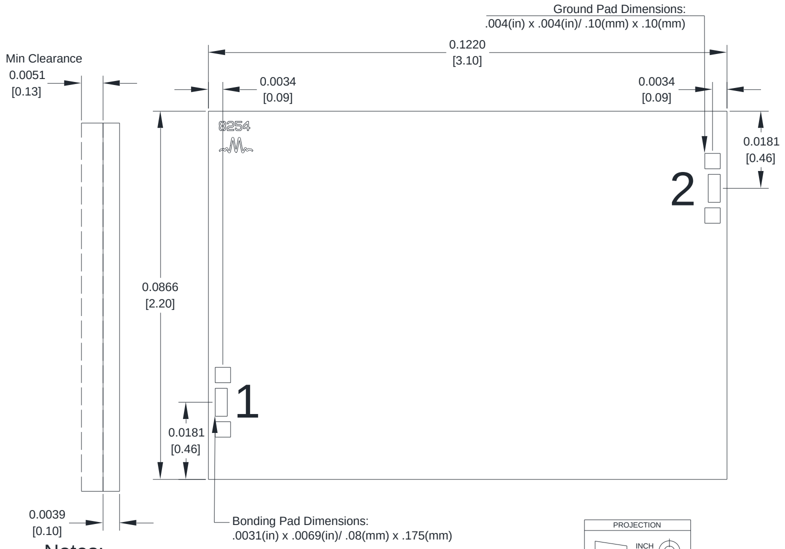


PROJECTION INCH [MM]

Notes:

1. CH substrate is .004 Thick GaAs.
2. I/O trace is 5 microns Au. Ground is 4 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.

MFBC-00019CH

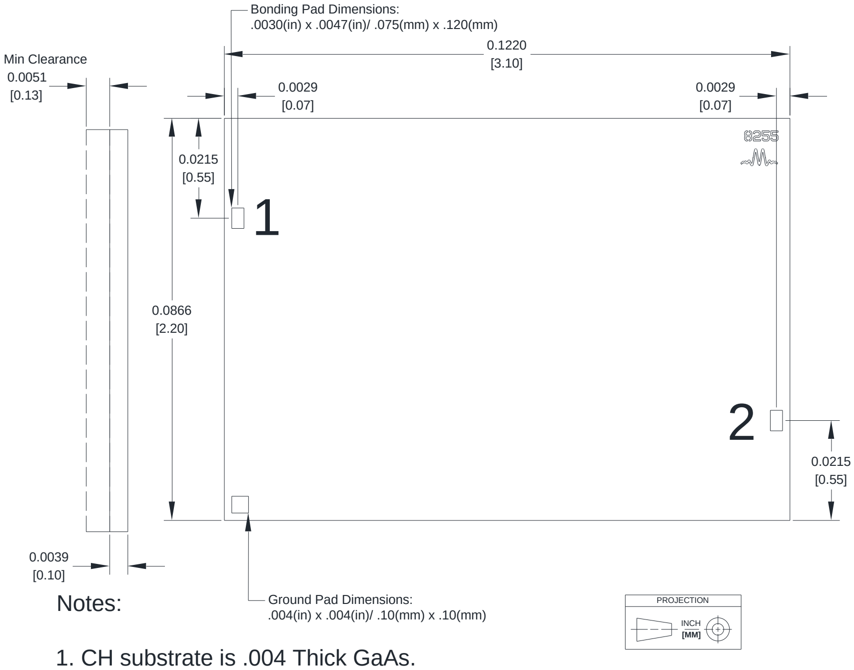


PROJECTION INCH [MM]

Notes:

1. CH substrate is .004 Thick GaAs.
2. I/O trace is 5 microns Au. Ground is 4 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.

MFBC-00020CH



Notes:

1. CH substrate is .004 Thick GaAs.
2. I/O trace is 5 microns Au. Ground is 4 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.