

# Directional Coupler

## 5 - 55 GHz



MACP-011113  
Rev. V2

### Features

- Broadband: 5 to 55 GHz
- Low Insertion Loss: 1 dB @ 50 GHz
- High Isolation: 35 dB @ 30 GHz
- Coupling Factor: 18 dB
- On-Chip 50  $\Omega$  Termination
- Miniature Lead-Free Surface Mount Package
- RoHS\* Compliant

### Applications

- Test and Measurement

### Description

The MACP-011113 is a fully integrated 5 - 55 GHz directional coupler with a 50 Ohm on-chip termination, offering best in class RF performance in a miniature package.

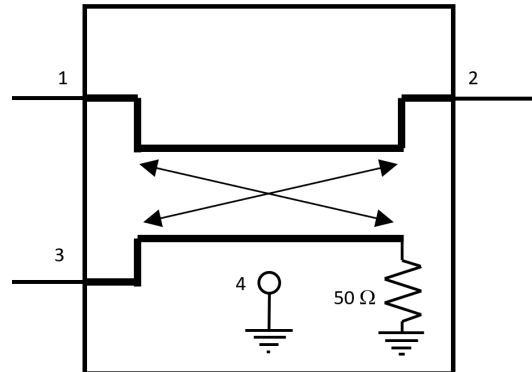
MACOM's proprietary HMIC™ process enables market leading lightweight passive components. MACP-011113 weighs just 2 mg.

### Ordering Information<sup>1,2</sup>

Part Number	Package
MACP-011113	Gel Pack
MACP-011113-TR0100	100 Piece Reel
MACP-011113-TR0500	500 Piece Reel
MACP-011113-SB1	Sample Board

1. Reference Application Note M513 for reel size information.
2. All sample boards include 5 loose parts.

### Functional Schematic



### Pin Names

Pin #	Function
1, 2	$R_{FIN} / R_{FOUT}$
3	Coupled Port
4	GND <sup>3</sup>

3. The exposed die backside GND metal must be connected to RF, DC and thermal ground.

### Pin Description

Pin 1	Pin 2	Pin 3	Pin 4
Input	Output	Coupled	Ground

\* Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

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### AC Electrical Specifications: $T_A = 25^\circ\text{C}$ , $Z_0 = 50 \Omega$

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss	5 - 15 GHz	dB	—	0.3	—
	15 - 45 GHz			0.6	
	45 - 55 GHz			1.0	
Coupling	5 - 15 GHz	dB	—	23	—
	15 - 45 GHz			18	
	45 - 55 GHz			25	
Return Loss, S11 & S22	5 - 15 GHz	dB	—	35	—
	15 - 45 GHz			30	
	45 - 55 GHz			17	
Return Loss, S33	5 - 15 GHz	dB	—	22	—
	15 - 45 GHz			17	
	45 - 55 GHz			12	
Isolation	5 - 15 GHz	dB	—	45	—
	15 - 45 GHz			33	
	45 - 55 GHz			38	
Directivity	5 - 15 GHz	dB	—	22	—
	15 - 45 GHz			15	
	45 - 55 GHz			13	

### Recommended Operating Conditions<sup>4</sup>

Parameter	Unit	Min.	Typ.	Max.
RF Input Power, port 3 (coupled port) <sup>5</sup>	dBm	—	—	+12
RF Input Power, port 1 & 2 (through line) <sup>5</sup>	dBm	—	—	+30
DC Current, port 3 (coupled port) <sup>5</sup>	mA	—	—	16
DC Current, port 1 & 2 (through line) <sup>5</sup>	A	—	—	1.8
Operating Temperature	$^\circ\text{C}$	-55	—	+105

4. All pins and frequencies.

5. See derating graph.

### Absolute Maximum Ratings<sup>6,7</sup>

Parameter	Unit	Min	Max
RF Input Power, port 3 (coupled port)	dBm	—	+23
RF Input Power, port 1 & 2 (through line)	dBm	—	+41
DC Current, port 3 (coupled port)	mA	—	50
DC Current, port 1 & 2 (through line)	A	—	4.0
Storage Temperature	$^\circ\text{C}$	-55	+105

6. Exceeding any one or combination of these limits may cause permanent damage to this device.

7. MACOM does not recommend sustained operation near these survivability limits.

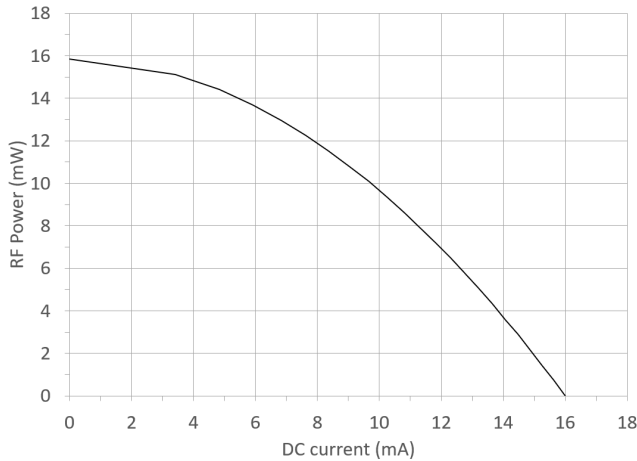
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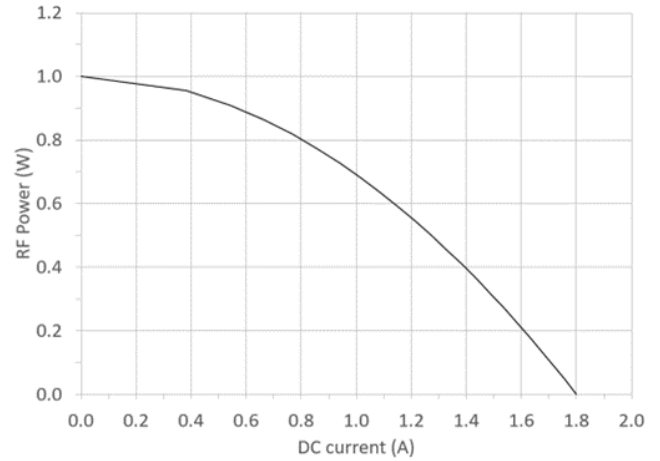


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**De-Rating Curve @  $T_A = +105^\circ\text{C}$ ,  
Ports 3, Coupled Port:**  
Maximum Operating RF Input Power vs. DC Input Current

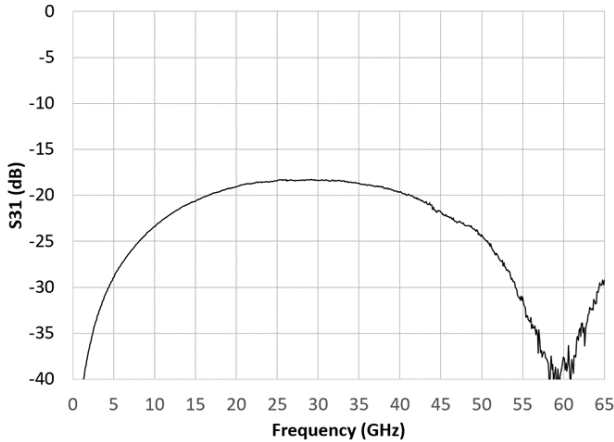


**De-Rating Curve @  $T_A = +105^\circ\text{C}$ ,  
Ports 1 and 2, Through Line:**  
Maximum Operating RF Input Power vs. DC Input Current

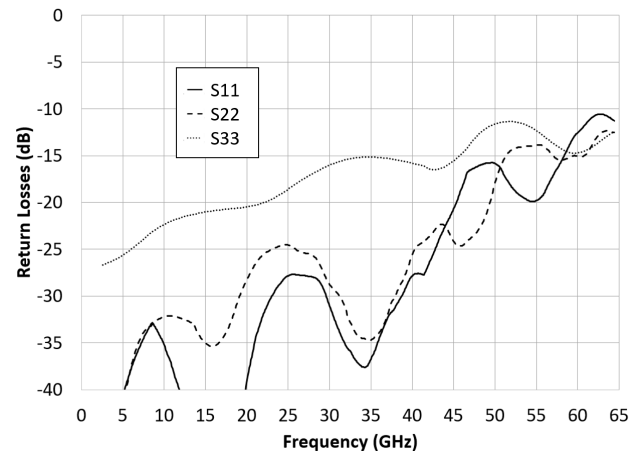


### Typical Performance Curves: All Configurations

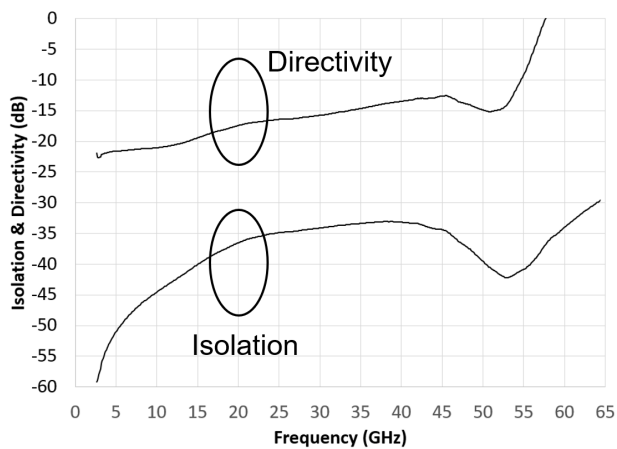
#### Coupling



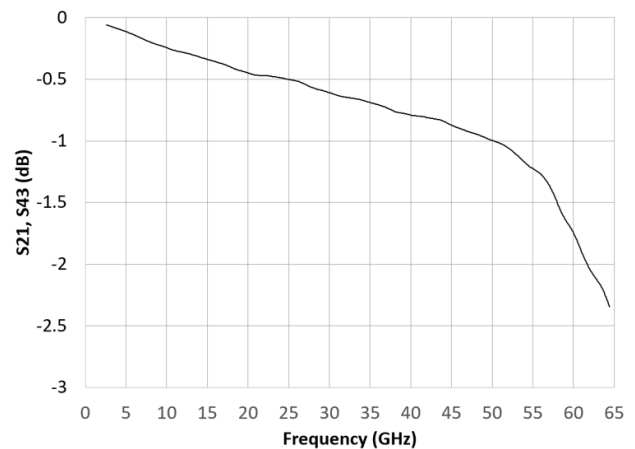
#### Return Loss



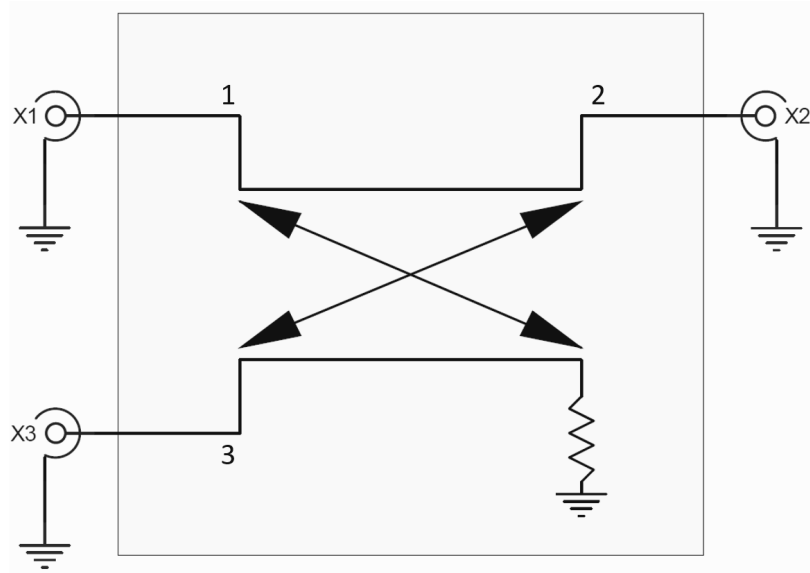
#### Isolation



#### Insertion Loss



**Application Schematic**



**Mounting Techniques**

Reference MACOM Application Note M538 for lead-free solder reflow recommendations. The gold plating on the back side of the die is 0.1  $\mu\text{m}$  thick. For a suitable solder attach ensure the PCB is gold plated with a thickness of between 0.05 - 0.15  $\mu\text{m}$ .

**Static Sensitivity**

These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

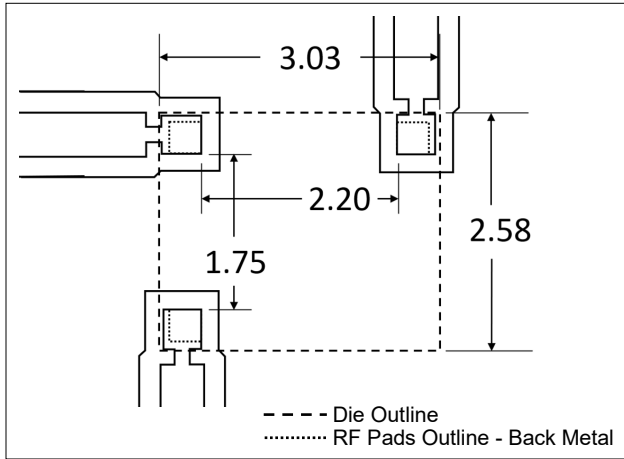
# Directional Coupler 5 - 55 GHz



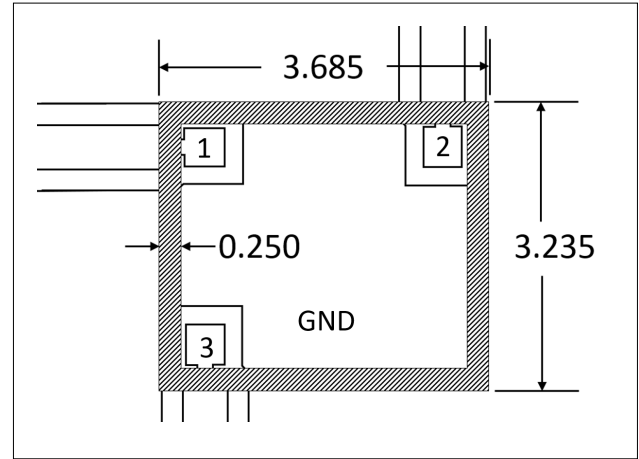
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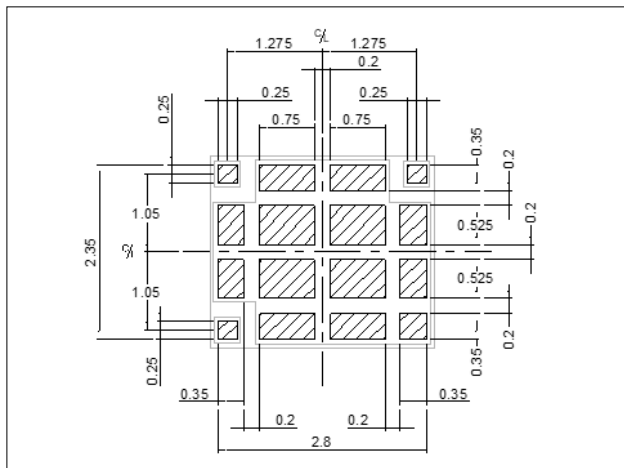
## Recommended PCB footprint<sup>8,9</sup>



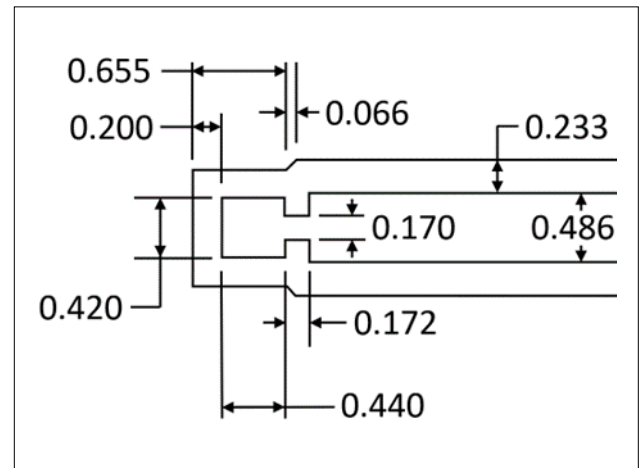
## Solder Mask Coverage<sup>8</sup>



## GND Metal Solder Paste Template<sup>8,9</sup>

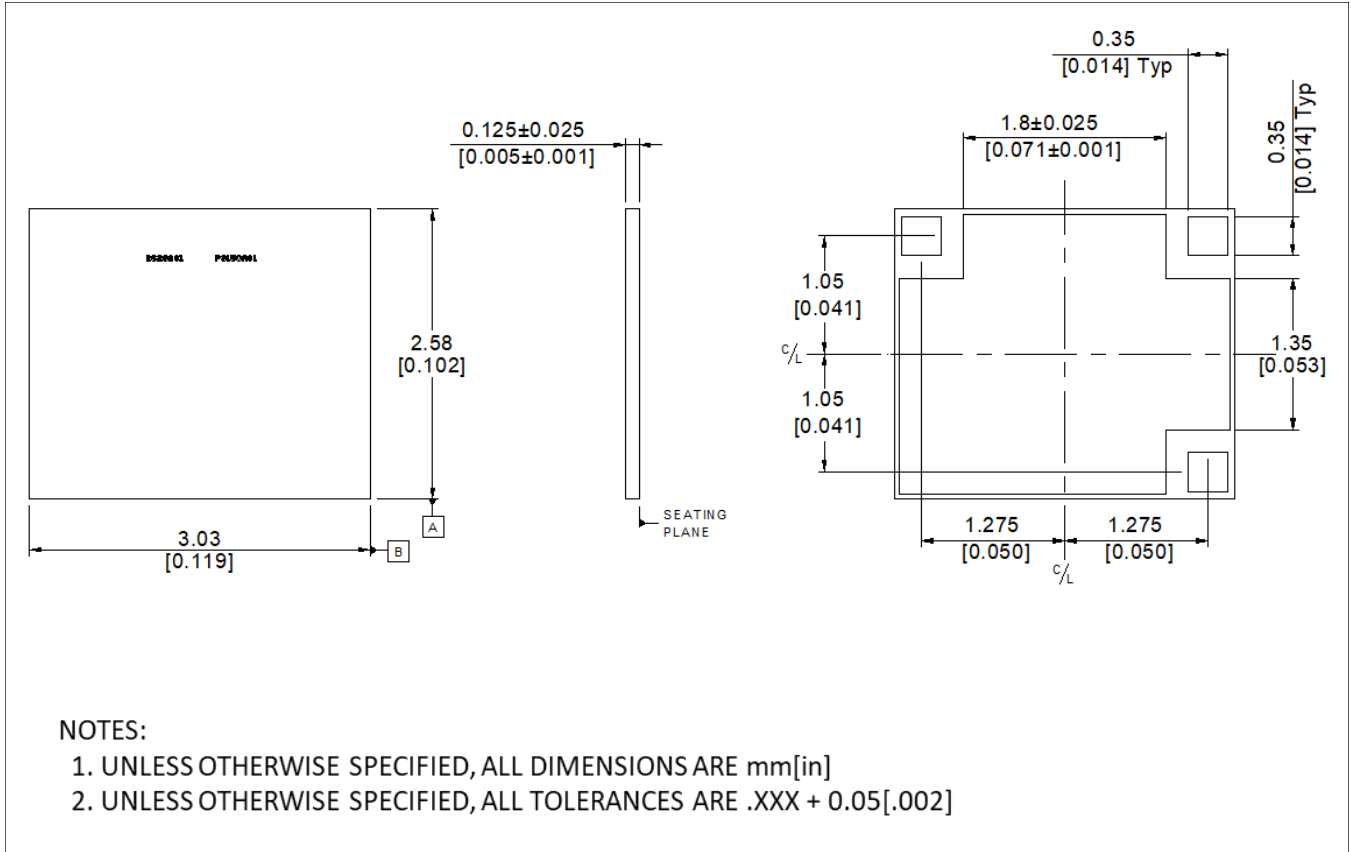


## RF Line Dimensions<sup>8,10</sup>



- 8. Dimensions in mm.
- 9. The exposed die backside GND metal must be connected to RF, DC and thermal ground.
- 10. Track dimensions apply to 44  $\mu$ m thick copper on 0.254 mm Rogers 4350B.

**Die Outline Drawing**



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