8.5-11 GHz 70W GaN PA MMIC

ICP1048

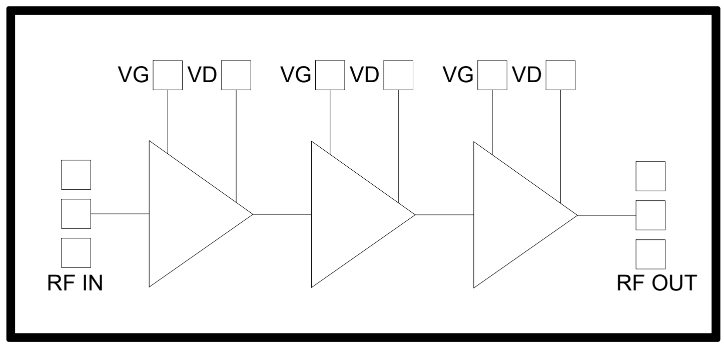
Product Overview

ICONICRF's ICP1048 is a three stage MMIC power amplifier in flange package, fabricated using GaN on SiC technology. ICP1048 operates from 8.5 — 11GHz with 48.5dBm output power, 35% PAE and 24dB small signal gain. ICP1048 is well suited to a variety of Communication Infrastructure and Aerospace & Defense applications

Key Features

- **Frequency Range: 8.5 - 11GHz**
- **P_{out}: 48.5dBm @ 26dBm P_{in}**
- **PAE: 35%**
- **Small Signal Gain: 24dB**
- **Bias: V_D=28V, I_{DQ}=400mA**
- **Technology: GaN on SiC**
- **Lead-free and RoHS compliant**
- **Die Size: 4.7mm x 4.55mm**

Functional Block Diagram



Applications

- Communication Infrastructure
- Aerospace & Defense

Electrical Specifications

Test Conditions unless otherwise stated: V_D = 28V, I_{DQ} = 400mA, T_A = 25°C, Pulsed 10% (100μs/1ms)

Parameter	Min.	Typ.	Max.	Units	Conditions[1]
Frequency	8.5		11	GHz	
Output Power at P_{sat}		48.5		dBm	P_{in} = 26dBm
Power Added Efficiency, PAE at P_{sat}		35		%	P_{in} = 26dBm
Small Signal Gain, S_{21}		24		dB	
Input Return Loss		10		dB	
Output Return Loss		6		dB	
I_{DQ}		400		mA	

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1. Electrical Specifications

1.1 Absolute Maximum Ratings

Parameter	Absolute Maximum
Drain Voltage (V_D)	30V
Gate Voltage (V_G)	-5 to 0V
Channel Temperature	275°C
Storage Temperature	-65°C to +150°C

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

Microchip Technology Inc. does not recommend sustained operation near these survivability limits.

1.2 Small Signal Performance

Typical Power Data over Temperature

Test conditions: V_D=28V, I_{DQ}=400mA

Figure 1-1. S_{21} vs Freq

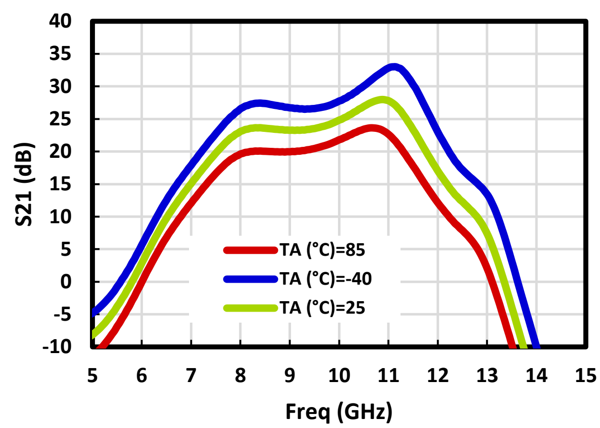


Figure 1-2. S_{11} vs Freq

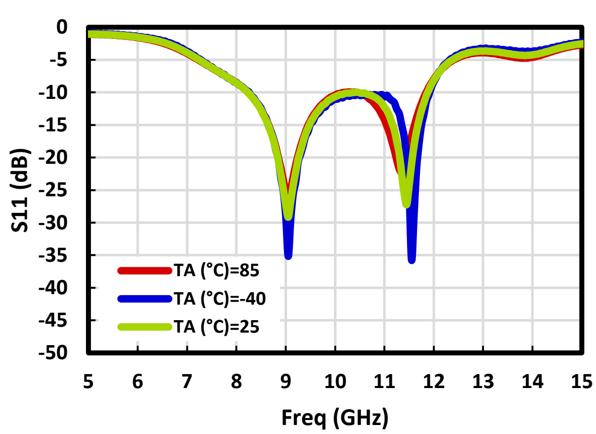
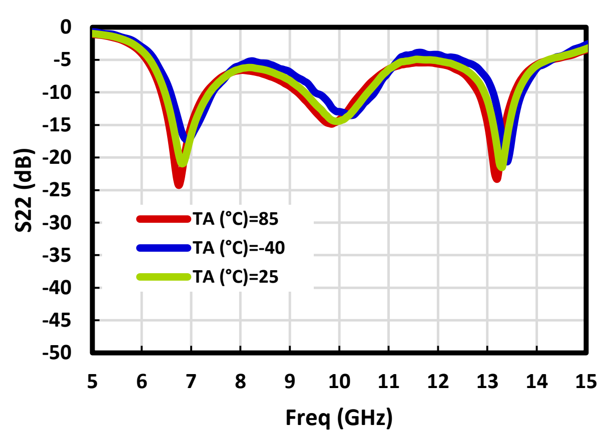


Figure 1-3. S_{22} vs Freq



1.3 Large Signal Performance

Typical Pulsed Power Data

Test conditions: V_D=28V, I_{DQ}=400mA, T_A=25°C, Pulsed 10% (100µs/1ms)

Figure 1-4. P_{out} vs. P_{in}

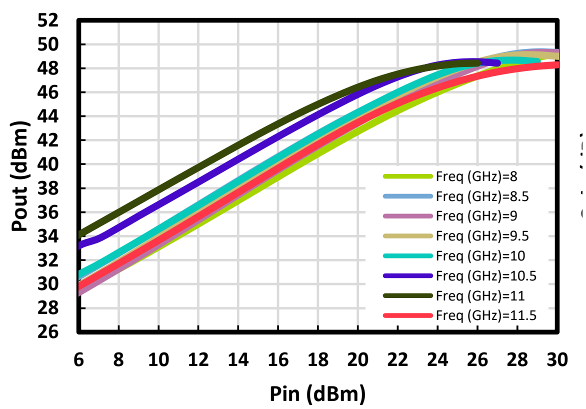


Figure 1-5. Gain vs. P_{out}

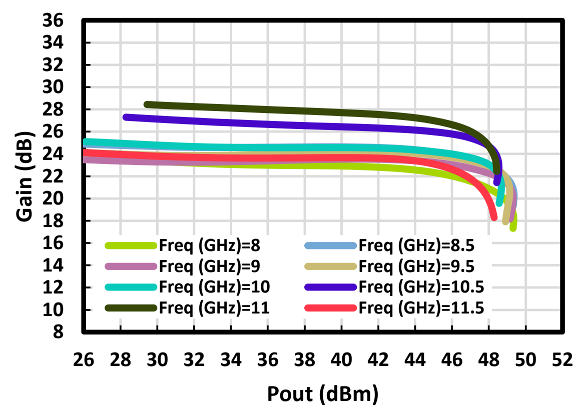


Figure 1-6. PAE vs. P_{out}

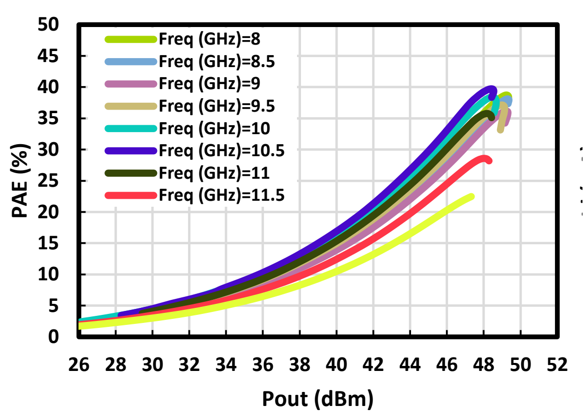


Figure 1-7. I_D vs. P_{out}

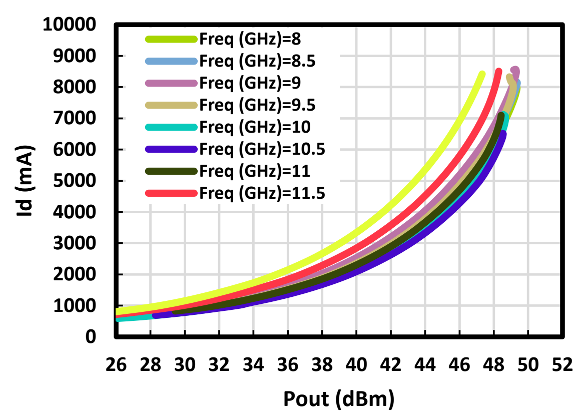


Figure 1-8. P_{out} vs. Freq

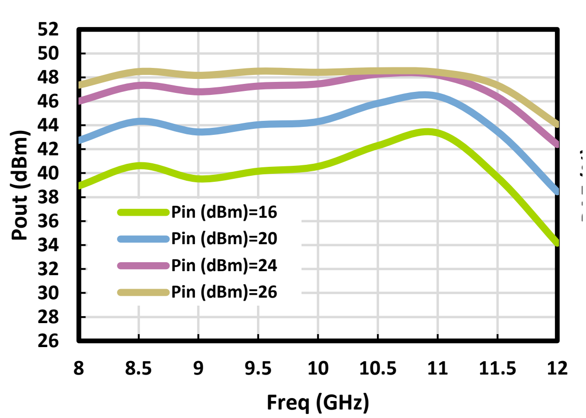
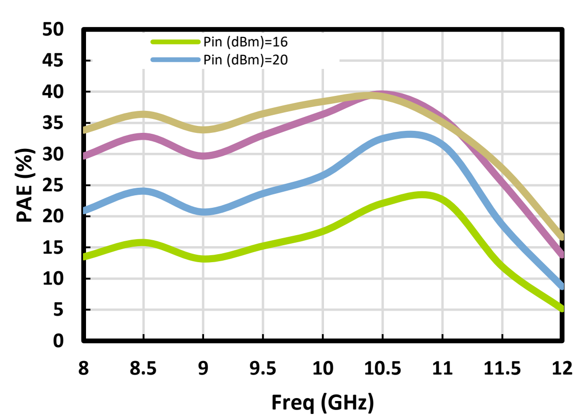


Figure 1-9. PAE vs. Freq



Typical Pulsed Power Data over T_A Conditions

Test conditions: V_D=28V, I_{DQ}=400mA, Pulsed 10% (100µs/1ms)

Figure 1-10. P_{out} vs. P_{in}, Freq=8GHz

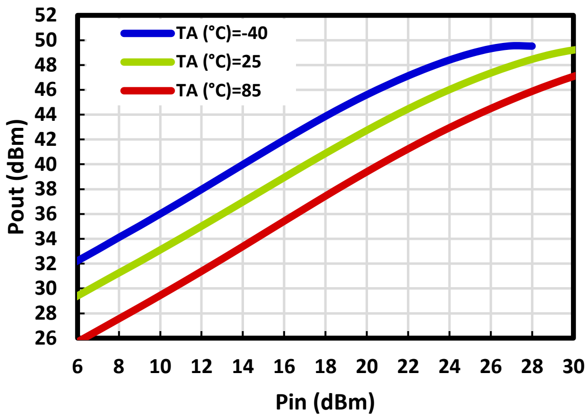


Figure 1-11. P_{out} vs. P_{in}, Freq=9GHz

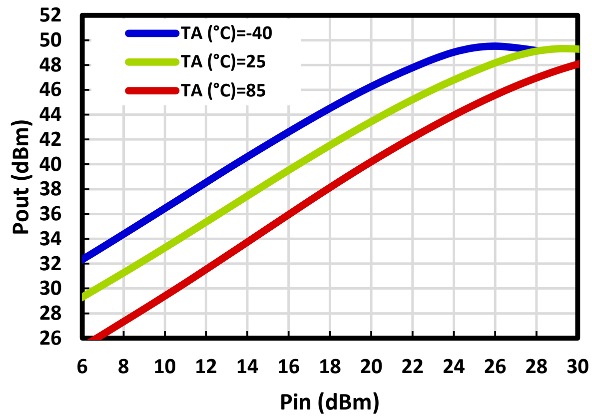


Figure 1-12. P_{out} vs. P_{in}, Freq=10GHz

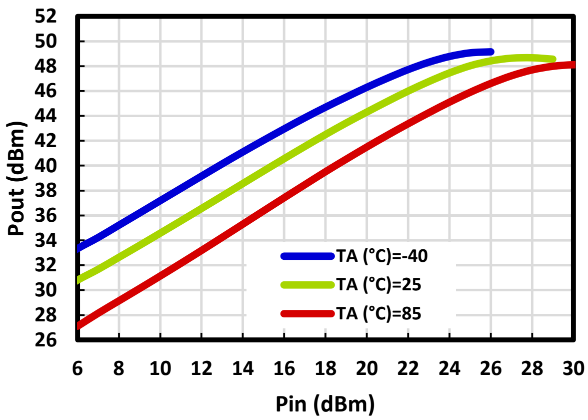


Figure 1-13. P_{out} vs. P_{in}, Freq=11GHz

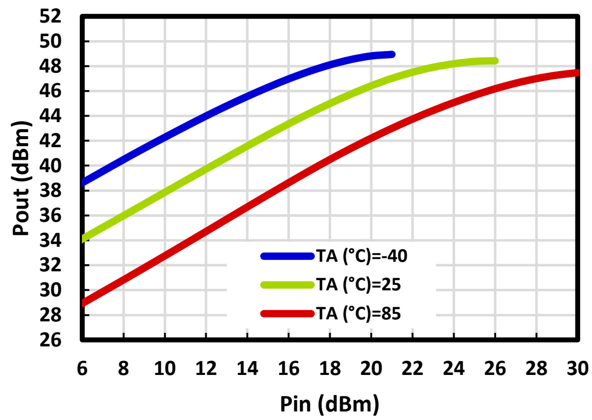


Figure 1-14. P_{out} vs. Freq

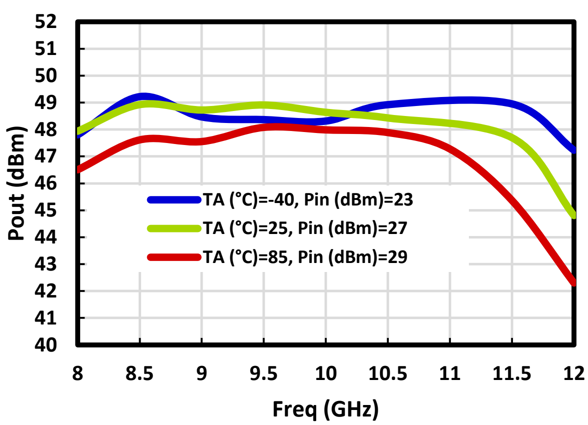
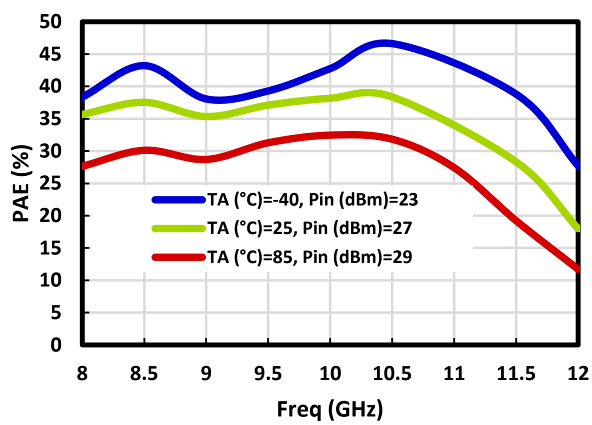
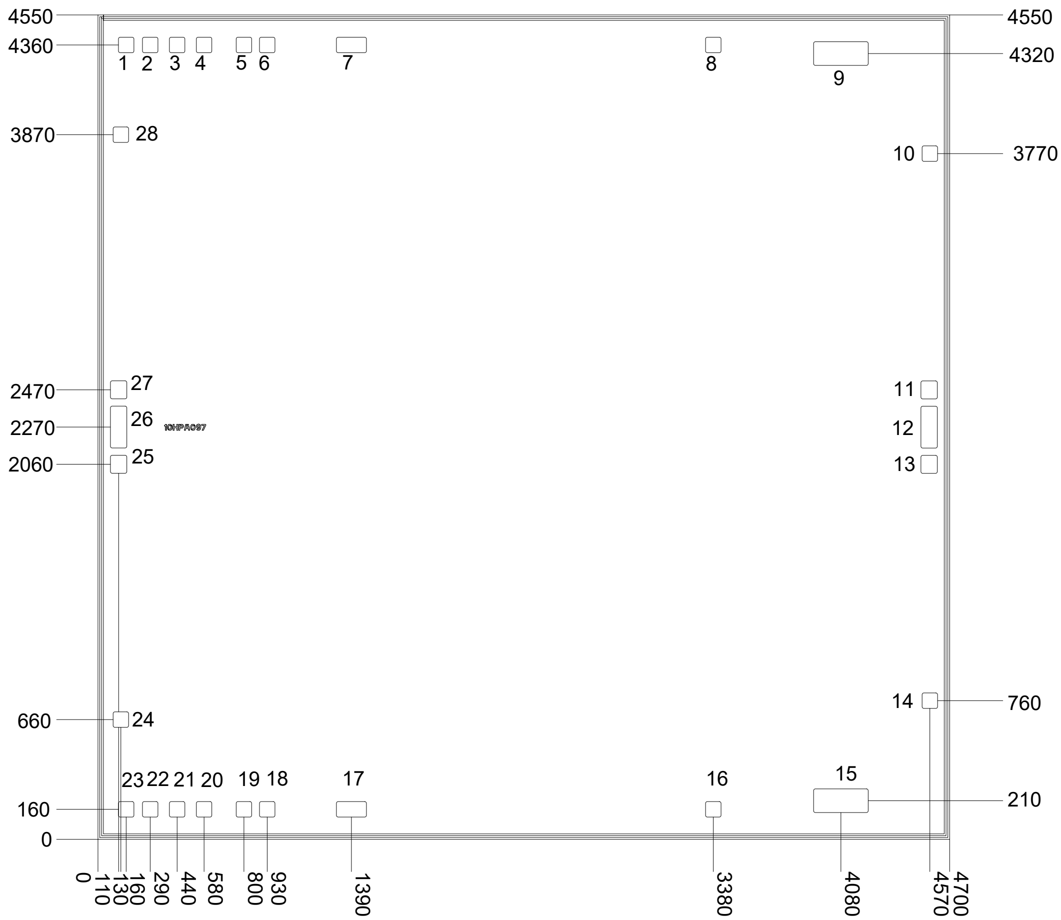


Figure 1-15. Gain vs. Freq



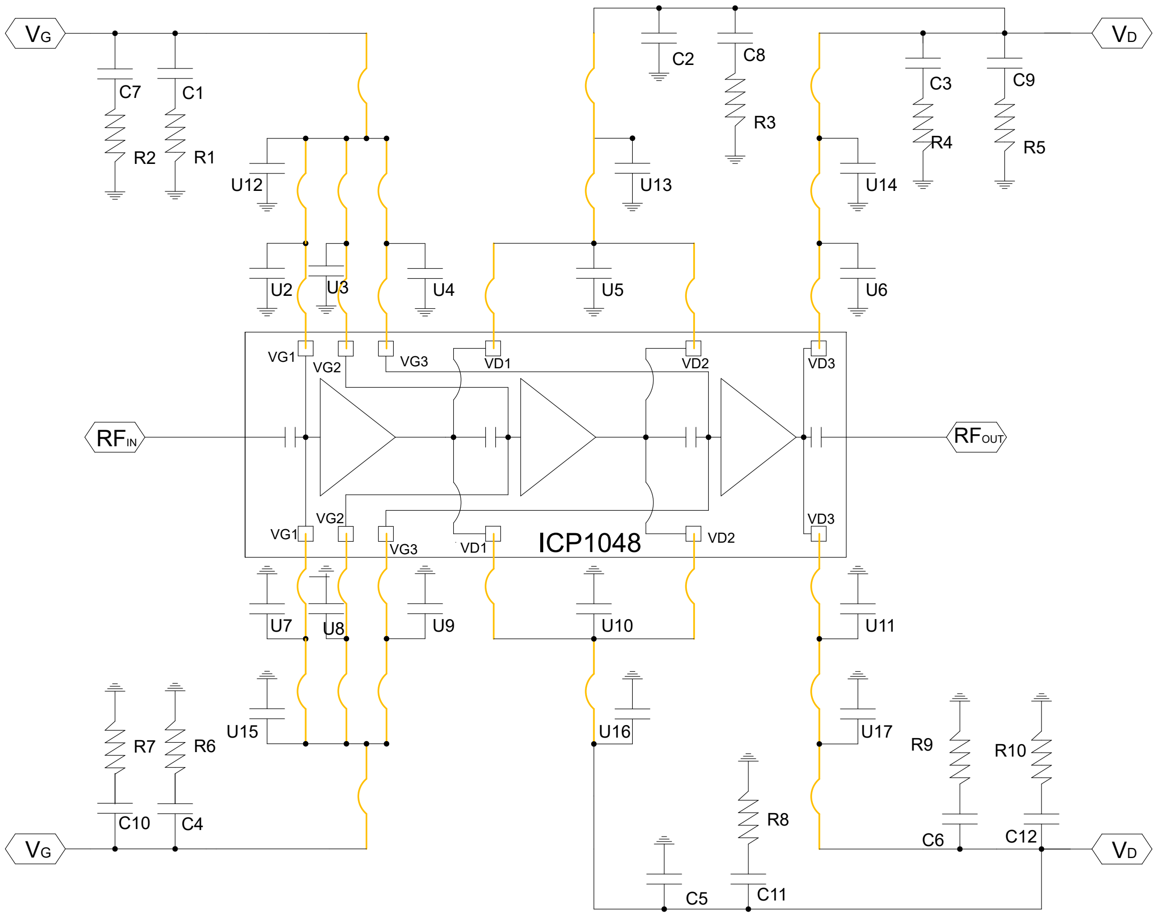
2. Mechanical Drawing



Units: µm | Thickness: 0.1mm | Backside of Die is RF and DC ground

Pad No	Pad size (µm)	Function	Description
1, 6, 8, 10, 14, 16, 18, 22, 24, 28	85 x 85	No Connect	Pad can be connected to ground or left open circuit
2 – 4, 20 – 22	85 x 85	V_G	Gate bias, decoupling and bypass caps required. Bias must be applied to all pins
5, 19	85 x 85	V_{D1}	Drain bias, decoupling and bypass caps required. Bias must be applied to both pins
7, 17	165 x 85	V_{D2}	Drain bias, decoupling and bypass caps required. Bias must be applied to both pins
9, 15	300 x 130	V_{D3}	Drain bias, decoupling and bypass caps required. Bias must be applied to both pins
11, 13, 25, 27	99 x 90	GND	Ground connection
12	90 x 320	RF_{out}	50Ω RF output. DC blocked
26	90 x 320	RF_{in}	50Ω RF input. DC blocked
Backside of Chip	4700 x 4550	GND	RF and DC ground

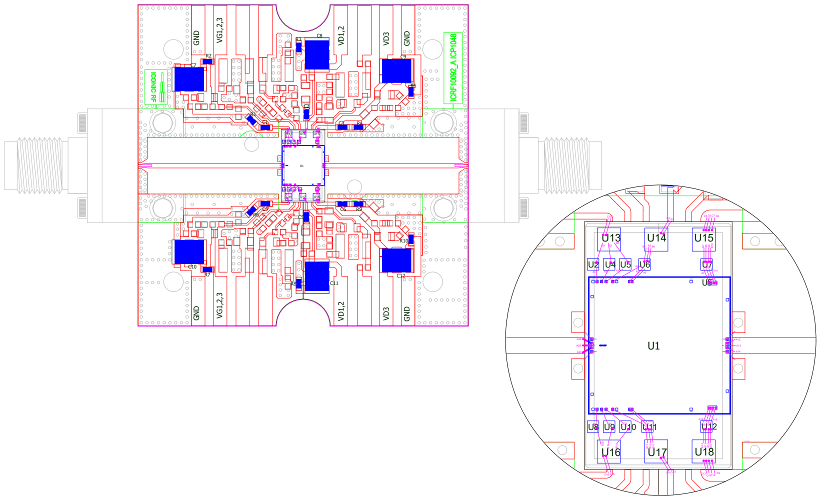
3. Application Circuit



Bill of materials

Component ID	Value	Details	Manufacturer Part No.
U2 - U11	100pF	MIM Capacitor	Various
U12 - U17	10nF	MIM Capacitor	Various
C1 - C6	10nF	10nF Capacitor,10%,50V,0402	Various
C7 - C12	10µF	10µF Capacitor,10%,50V,1206	Various
R1 - R10	5.1Ω	5.1Ω Resistor, 0402	Various

4. Evaluation Board



Evaluation board construction

Interconnect assembly Notes	Die attach using Eutectic
· Ball Bonding is preferred technique · Force, time and ultrasonic parameters are critical. · Aluminum wire bonding is not recommended. · Bond Wire diameter of 1mil is recommended.	· Flux-less gold-tin (AuSn) (80% Au, 20% Sn with a melting point of 280°C) preform is preferred between the die and attached surface. · Recommended preform should be approximately 0.0012" thick. · Die bonder using heated collet with a temperature of 310°C and die scrubbing should be used to ensure wetting and prevent formation of voids. · Exposure to extreme temperature should be kept to a minimum. · The optimum die attach environment is nitrogen atmosphere.

Die attach of component using adhesive	Re-flow Process
· Vacuum collets are preferred method of pickup. · Pickup method must consider the avoidance of die air bridges. · Die suitable for Eutectic and Epoxy die attach. · Where Epoxy is used, high thermal conductivity Silver Sintered Epoxy is recommended:- · Kyocera CT2700R7S · Namics H9889-1	· Maximum temperature 320°C for 30 seconds. · Material matching for coefficient of thermal expansion is crucial for long-term reliability

PCB Construction	Details
Top & Bottom Layer	0.5oz Cu + ENEPIG
Electroless Nickel	3-6µm
Electroless Palladium	0.05-0.3µm
Immersion Gold	0.04-0.06µm

Key Features	Details
Dielectric	RO4003C
Overall Thickness	Approx 0.27mm
VIA Plating Thickness	>15µm

Note:
Optimum RF power performance achieved by minimizing output RF bond wire length.

5. Ordering, Shipping, and Handling

Handling Recommendations

Integrated circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. It is recommended to follow all procedures and guidelines outlined in the Microsemi application note AN01: GaAs MMIC Handling and Die Attach Recommendations.

Ordering Information

For additional ordering information, contact your Microchip sales representative.

Part Number	Description
ICP1048-1-110I	Gel Pak Au Backed
ICP1048-1-101I	Wafer on expander ring
ICP1048-1-103I	Wafer on metal frame
EV48G16A	ICP1048-1-501U EVB - connector SMA

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