

# 8.5-11GHz 70W GaN PA MMIC

## ICP1048P



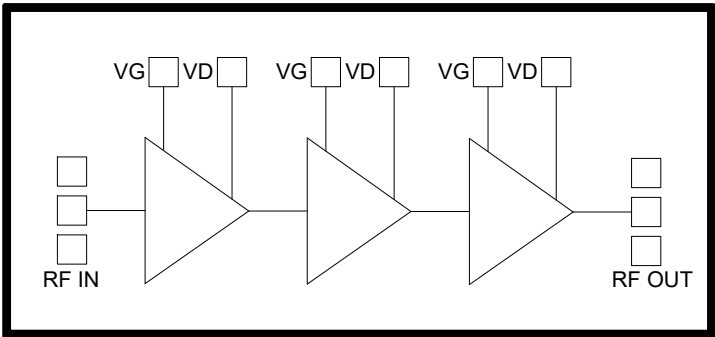
### Product Overview

ICONICRF's ICP1048P is a three stage MMIC power amplifier in flange package, fabricated using GaN on SiC technology. ICP1048P operates from 8.5-11GHz with 48.5dBm output power, 35% PAE and 23dB 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<sub>out</sub>: 48.5dBm @26dBm P<sub>in</sub>**
- **PAE: 35% @26dBm P<sub>in</sub>**
- **Small Signal Gain: 23dB**
- **Bias: V<sub>D</sub>=28V, I<sub>DQ</sub>=360mA**
- **Technology: GaN on SiC**
- **Lead-free and RoHS compliant**
- **Flange Package**

#### Functional Block Diagram



#### Applications

- Communication Infrastructure
- Aerospace & Defense

#### Electrical Specifications

| Parameter                                       | Min. | Typ. | Max. | Units | Conditions <sup>(1)</sup> |
|-------------------------------------------------|------|------|------|-------|---------------------------|
| Frequency                                       | 8.5  |      | 11   | GHz   |                           |
| Output Power at P <sub>sat</sub>                |      | 48.5 |      | dBm   | P <sub>in</sub> = 26dBm   |
| Power Added Efficiency, PAE at P <sub>sat</sub> |      | 35   |      | %     | P <sub>in</sub> = 26dBm   |
| Small Signal Gain, S <sub>21</sub>              |      | 23   |      | dB    |                           |
| Input Return Loss                               |      | 10   |      | dB    |                           |
| Output Return Loss                              |      | 6    |      | dB    |                           |
| I <sub>DQ</sub>                                 |      | 360  |      | mA    |                           |

**Note:** (1) Test conditions unless otherwise stated V<sub>D</sub>=28V, I<sub>DQ</sub>=360mA, T<sub>A</sub>=25°C, Pulsed 10% (100µs/1ms)

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# 1. Electrical Specification

## 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:  $V_D=28V$ ,  $I_{DQ}=360mA$

Figure 1-1.  $S_{21}$  vs Freq

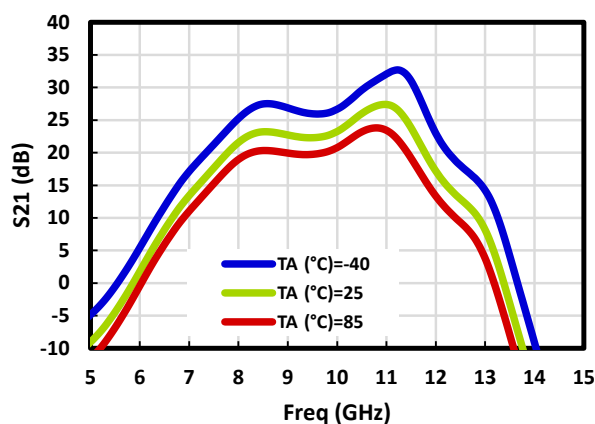


Figure 1-2.  $S_{11}$  vs Freq

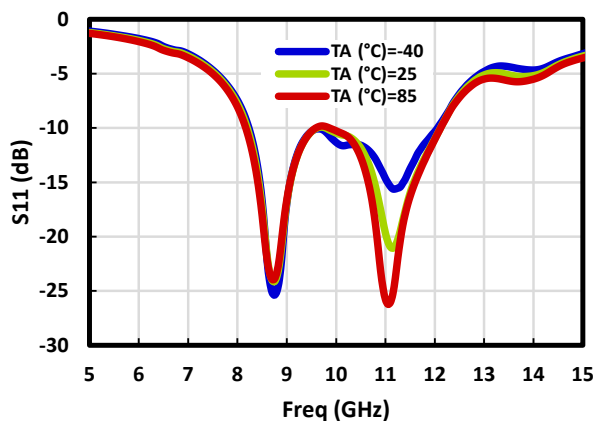
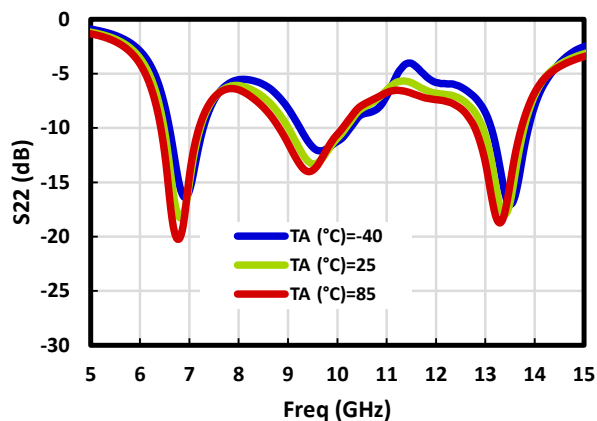


Figure 1-3.  $S_{22}$  vs Freq



## 1.3 Large Signal Performance

### Typical Pulsed Power Data

Test conditions:  $V_D=28V$ ,  $I_{DQ}=360mA$ ,  $T_A=25^\circ C$ , Pulsed 10% (100 $\mu s$ /1ms)

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

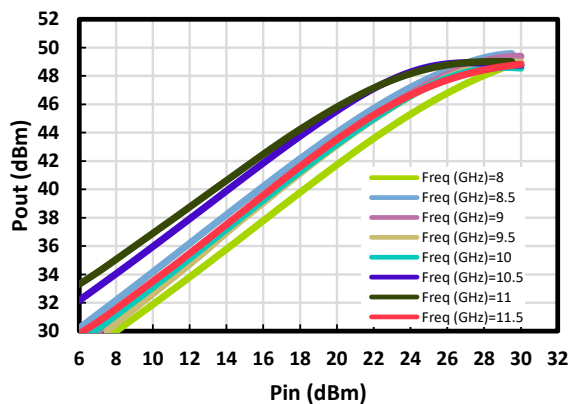


Figure 1-5. Gain vs.  $P_{out}$

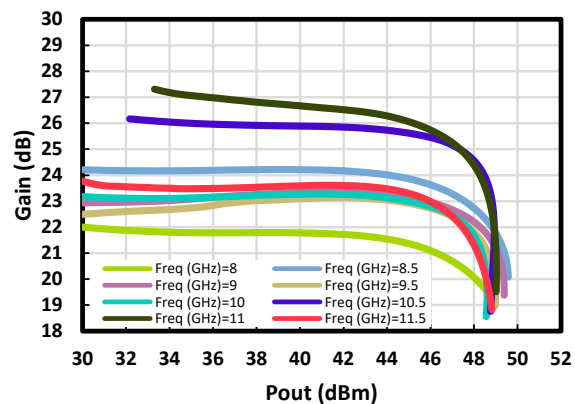


Figure 1-6. PAE vs.  $P_{out}$

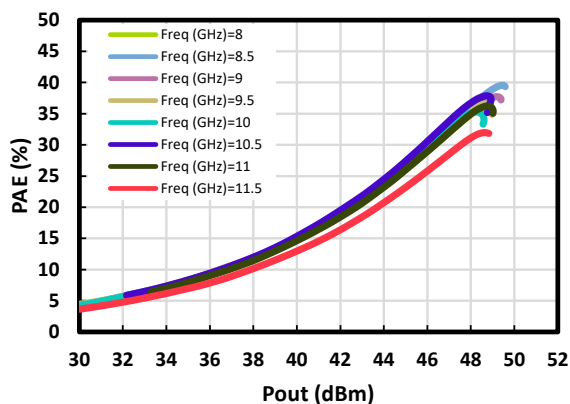


Figure 1-7.  $I_D$  vs.  $P_{out}$

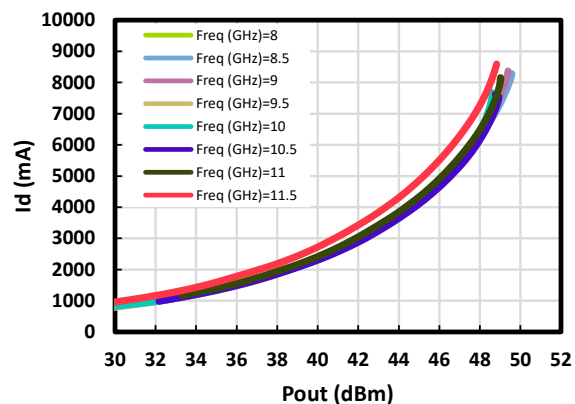


Figure 1-8.  $P_{out}$  vs. Freq

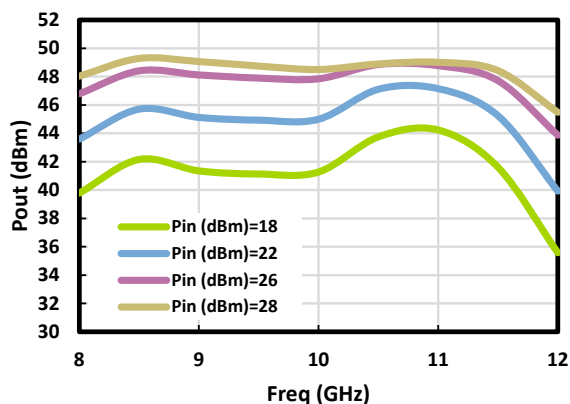
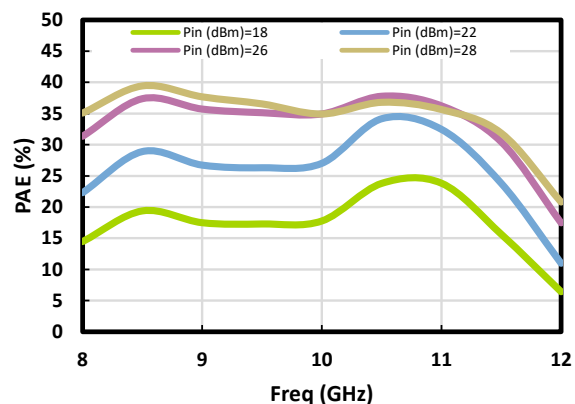


Figure 1-9. PAE vs. Freq



## Typical Pulsed Power Data over $T_A$ Conditions

Test conditions:  $V_D=28V$ ,  $I_{DQ}=360mA$ ,  $T_A=25^\circ C$ , Pulsed 10% (100 $\mu s$ /1ms)

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

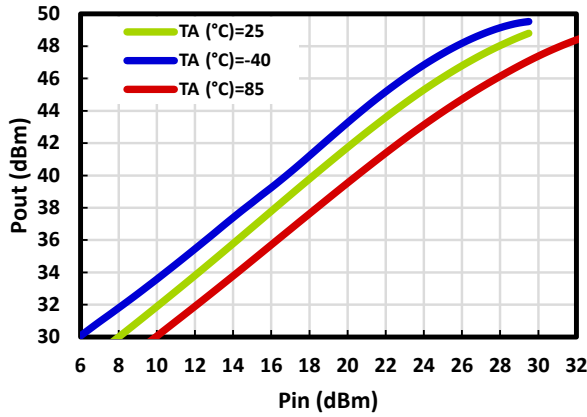


Figure 1-11.  $P_{out}$  vs.  $P_{in}$ , Freq=9GHz

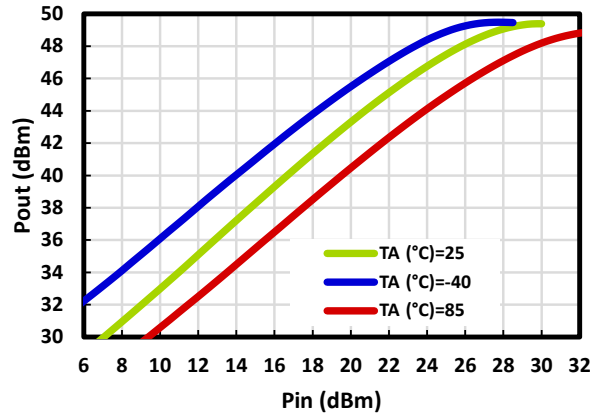


Figure 1-12.  $P_{out}$  vs.  $P_{in}$ , Freq=10GHz

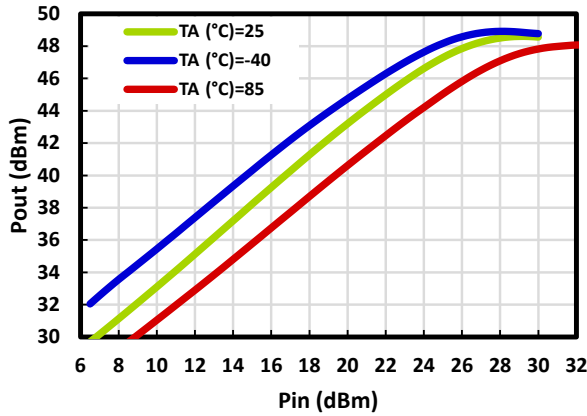


Figure 1-13.  $P_{out}$  vs.  $P_{in}$ , Freq=11GHz

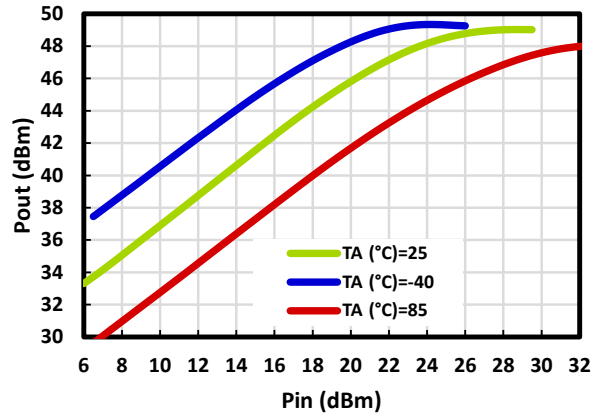


Figure 1-14.  $P_{out}$  vs. Freq

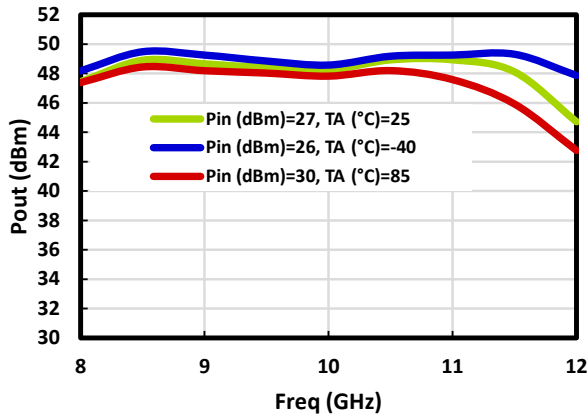
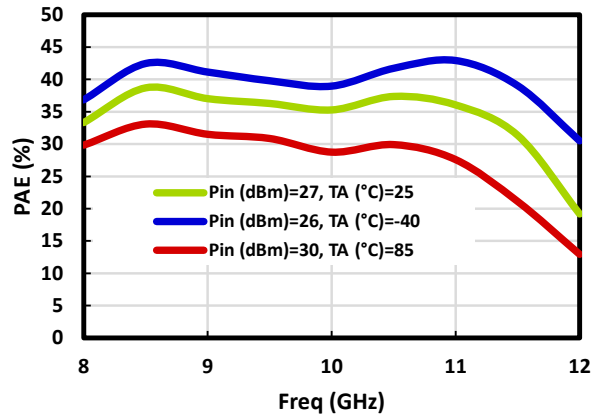
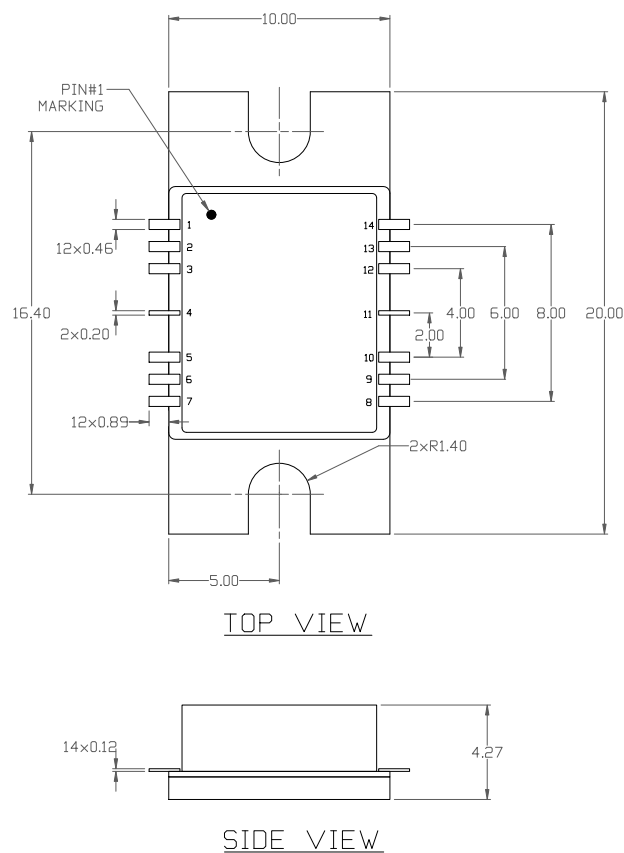


Figure 1-15. PAE vs. Freq



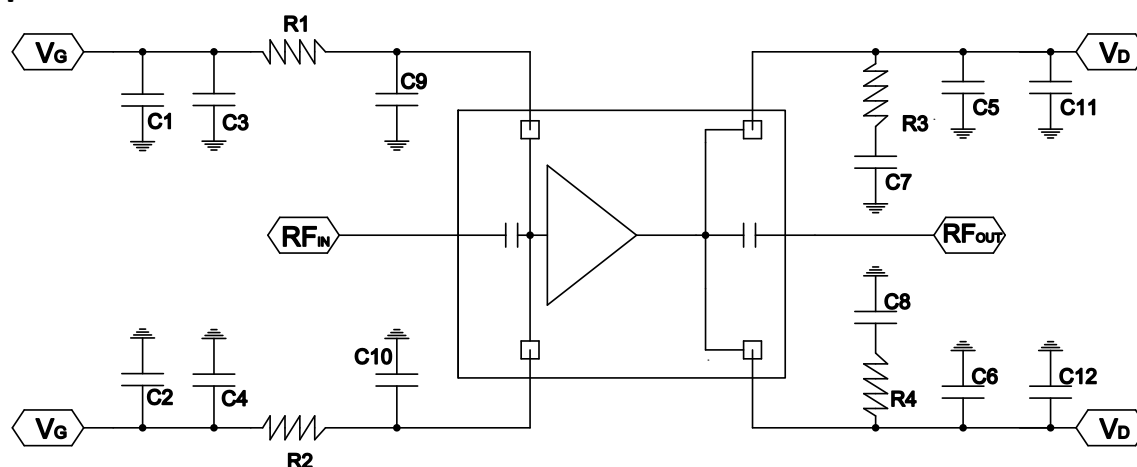
## 2. Mechanical Drawing



Units: mm

| Pad No       | Function          | Description                                                                        |
|--------------|-------------------|------------------------------------------------------------------------------------|
| 1, 7         | V <sub>G</sub>    | Gate bias, decoupling and bypass caps required. Bias must be applied to both pins  |
| 2, 6, 9, 13  | No connect        | Pin can be connected to ground or open circuit                                     |
| 3, 5, 10, 12 | GND               | Ground connection                                                                  |
| 4            | RF <sub>IN</sub>  | 50ohm RF input, DC blocked                                                         |
| 8, 14        | V <sub>D</sub>    | Drain bias, decoupling and bypass caps required. Bias must be applied to both pins |
| 11           | RF <sub>OUT</sub> | 50ohm RF output, DC blocked                                                        |
| Flange       | GND               | RF and DC ground                                                                   |

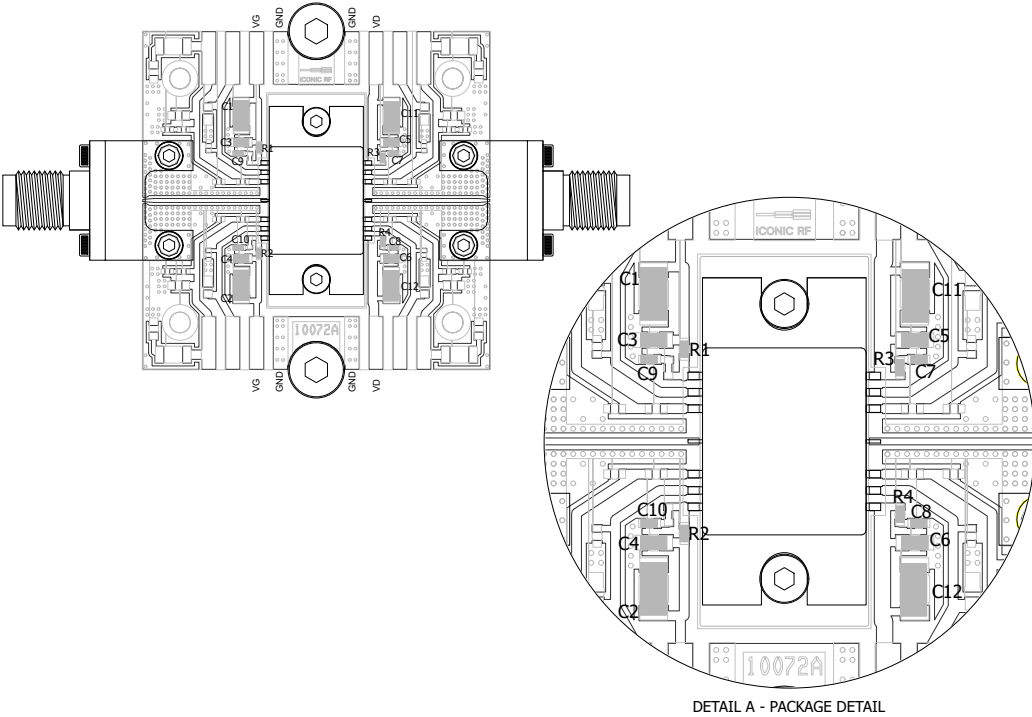
### 3. Application Circuit



#### Bill of materials

| Component ID     | Value   | Details                         | Manufacturer Part No. |
|------------------|---------|---------------------------------|-----------------------|
| C1, C2, C11, C12 | 10uF    | 10uF Capacitor, 10%, 35V, 1206  | Various               |
| C3 - C6          | 1uF     | 1uF Capacitor, 10%, 35V, 0603   | Various               |
| C7, C8           | 10nF    | 10nF Capacitor, 10%, 50V, 0402  | Various               |
| C9, C10          | 100nF   | 100nF Capacitor, 10%, 35V, 0603 | Various               |
| R1, R2           | 5.1Ohms | 5.1Ohm Resistor, 0402           | Various               |
| R3, R4           | 0Ohm    | 0Ohm Resistor, 0402             | Various               |

4. Evaluation Board



PCB Fabrication

| 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         |



## 5. Other considerations

### Assembly Guidance

The package must be bolted to a thermally conductive base plate and the pins aligned with the PCB tracks. For optimum thermal transfer use an electrically conductive thermal compound before fixing the package.

### Solderability

Its recommended to manually solder the leads to the PCB using a no-clean solder. This avoids washing the part after soldering.

Components are compatible lead-free solder with a temperature of 260°C

For optimum RF and thermal performance IconicRF recommends the die assembly base plate is adequately bolted to an forced air heat sink using a thermal graphite interface pad (Graphite Interface Material GCSP-017-G 17µm thick) for optimal heat transfer.

There are many variables of the second level assembly between the die base plate and heat sink that IconicRF are unable to control and the following guidance is provided as information only. Fixing bolts should be provided as close to the die as possible to ensure a optimum pressure between the base plate and the heat sink.

The bolting screws used to attach the PCB assembly to the heat sink must include washers and be tightened with a suitable tightening pattern to ensure a uniform pressure. It is advised all surfaces be cleaned and be free of grease and dust prior to fully aligning the assembly with all screws located and tightened to finger tight. Further torquing of the screws must be achieved in multiple phases using a star shaped pattern to a recommended torque of 2.5N/m.

### Bias-up procedure

1. Set  $V_G$  to -5V
2. Set  $V_D$  to 28V
3. Adjust  $V_G$  positive until  $I_D$  quiescent is 360mA
4. Limit  $I_D$  to 10A
5. Apply RF signal

### Bias-down procedure

1. Turn off RF
2. Turn off  $V_D$ , allow drain capacitors to discharge
3. Turn off  $V_G$

## 6. 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                                                        |
|----------------|--------------------------------------------------------------------|
| ICP1048-1-451I | Ceramic flange package                                             |
| EV38P20A       | Evaluation Board with SMA connectors (ICP1048-1-451I PCB Assembly) |

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