# ICP1937

17-21GHz 5W GaN PA MMIC

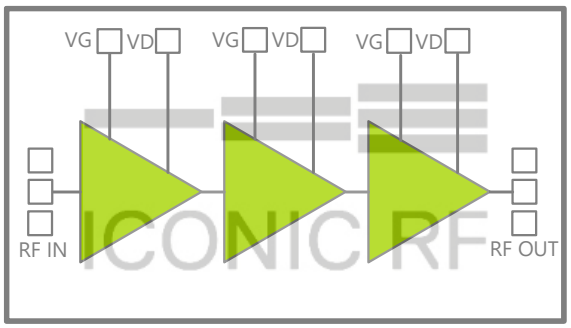
## Features

- Frequency Range: 17-21GHz
- Pout: 37 dBm @ 15dBm Pin
- PAE: >30 %
- Small Signal Gain: 28dB
- Bias: VD=24V IDQ=84mA
- Technology: GaN-on-SiC
- Lead-free and RoHS compliant
- Die Size: 3.2 mm x 2.6 mm

## Applications

- Point-to-Point Microwave Radio
- Satellite Communications

## Functional Diagram




## Description

The ICP1937 is a three stage MMIC power amplifier in bare die form, fabricated using GaN-on-SiC technology. The PA operates from 17-21GHz with 37dBm output power, >30% PAE and 28dB small signal gain. The die has integrated DC blocking capacitors and is matched to 50 Ohms on the RF input and output ports. The operating frequency provides flexible operation for a variety of applications including satellite and point-to-point microwave radio. The ICP1937 is 100% DC and RF tested on-wafer to ensure compliance with electrical specifications.

**Electrical Specifications** | Test Conditions unless otherwise stated | $V_D$=*24V*, $I_D$=*84mA*, *TA*=25 °C, CW

| Parameter | Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| Frequency | | 17.7 | | 21.2 | GHz |
| Output Power @ $P_{sat}$ | Pin=15dBm | | 37 | | dBm |
| PAE @ $P_{sat}$ | Pin=15dBm | | 30 | | % |
| Small Signal Gain | | | 28 | | dB |
| Input Return Loss | | | 12 | | dB |
| Output Return Loss | | | 8 | | dB |
| $I_{DQ}$ | | | 84 | | mA |
| $V_{GS}$ | | | 1.85 | | V |
| ID drive | Pout 37dBm | | 900 | | mA |

## Absolute Maximum Ratings

| Parameter | Absolute Maximum |
|---|---|
| Drain Voltage ($V_D$) | 30.0V |
| Gate Voltage Range ($V_G$) | -5 to 0V |
| Gate Current (IG) | 5mA |
| Drain Current (CW) $T_A$=25°C | 2.43A |
| Power Dissipation (CW) $T_A$=25°C<br>Power Dissipation (CW) $T_A$=85°C | 58W<br>40W |
| CW Input Power 50ohm, $T_A$=25°C | +20dBm |
| Channel Temperature | 275°C |
| Storage Temperature | -65°C to +150°C |
| Input Power VSWR (2:1),<br>$V_D$=20V, $I_{DQ}$=84mA<br>$V_D$=24V, $I_{DQ}$=84mA | 20dBm |
| Eutectic Die Attach Temperature (30s) | 320°C |

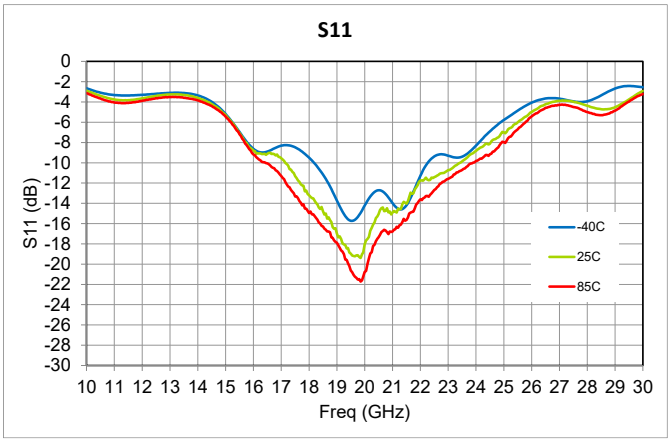
Exceeding any one or combination of these limits may cause permanent damage to this device.
Microchip Technology does not recommend sustained operation near these survivability limits.

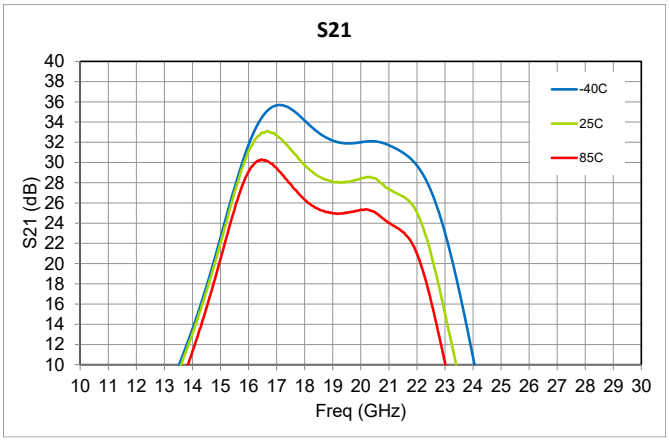
## Ordering Information

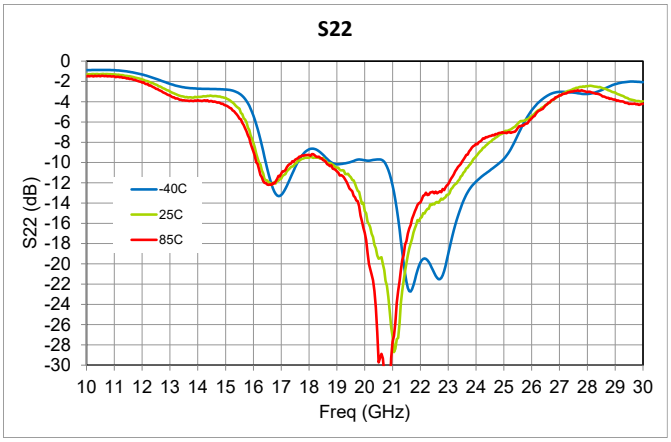
| Part No. | Description |
|---|---|
| ICP1937-1-110I | Bare die |
| ICP1937-1-501U | Evaluation Board with SMA connectors |

## Typical Performance

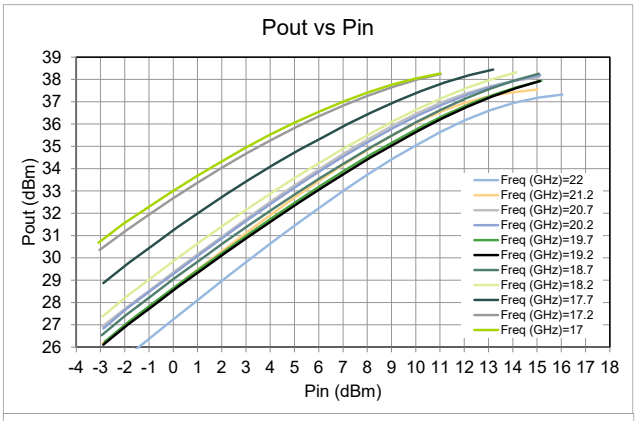
### S-Parameter Performance | Test Conditions unless otherwise stated | $V_D$=24V, $T_A$=-40°C, 25°C, +85°C, $I_D$=84mA

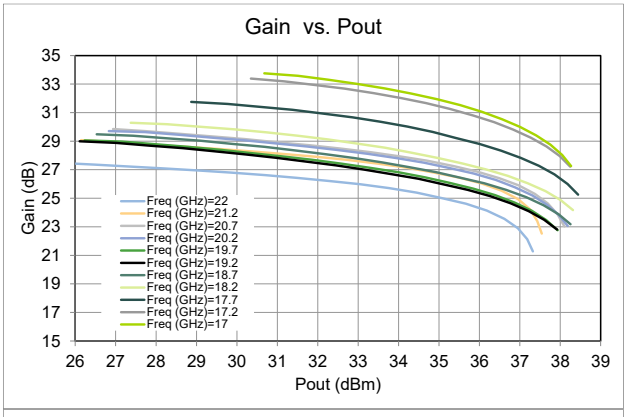


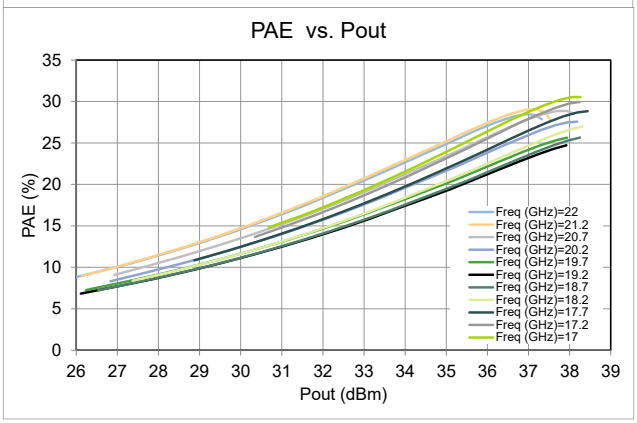



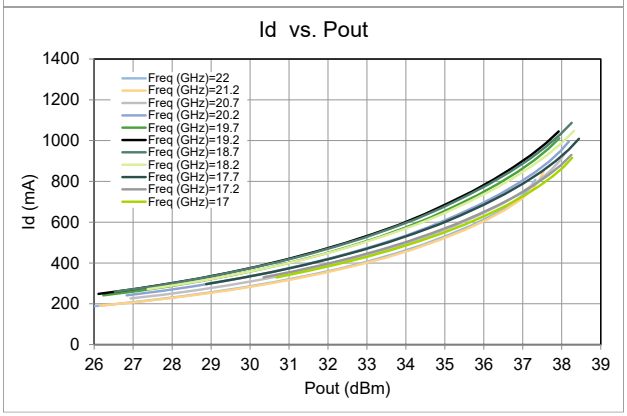



## Power Performance | Test Conditions unless otherwise stated | $V_D$=24V, $I_D$=84mA, $T_A$=25°C, CW

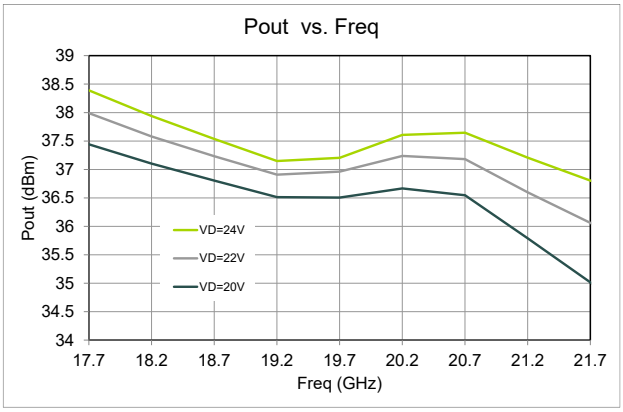


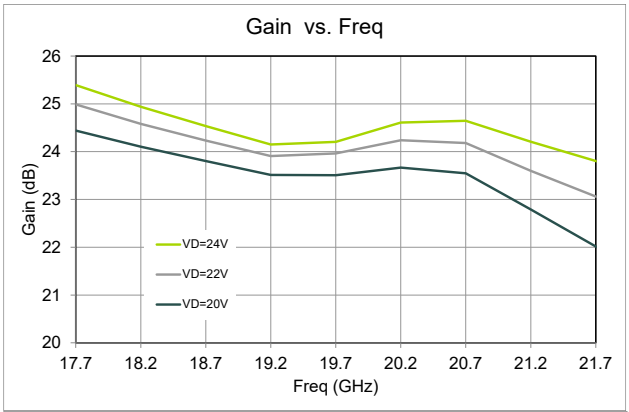



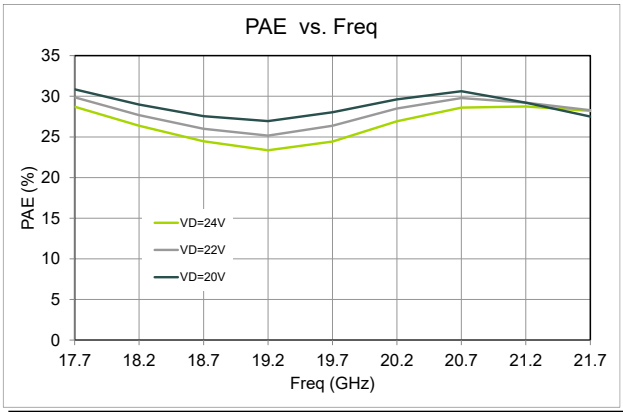



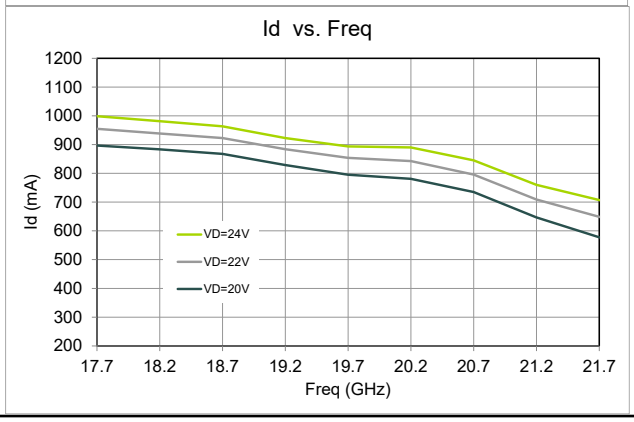




## Power Performance vs Frequency | Test Conditions unless otherwise stated | Pin=13dBm $I_D$=84mA, $T_A$=25°C, CW

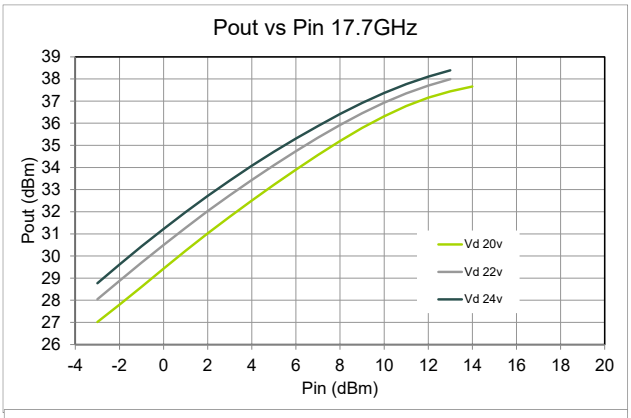


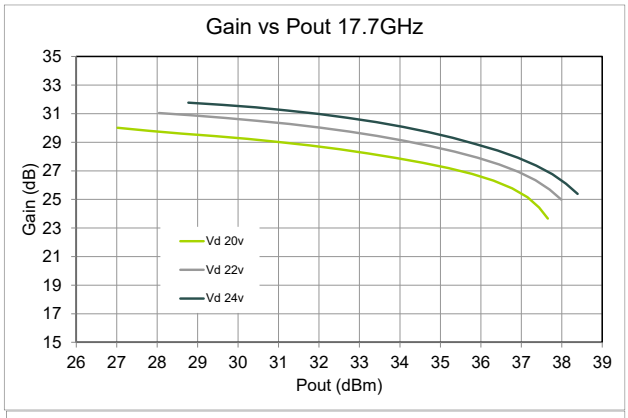



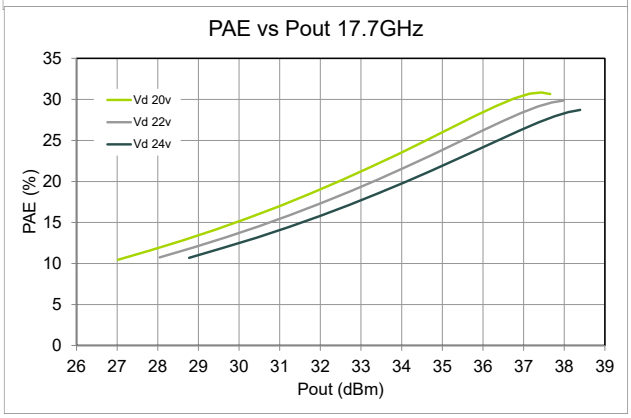



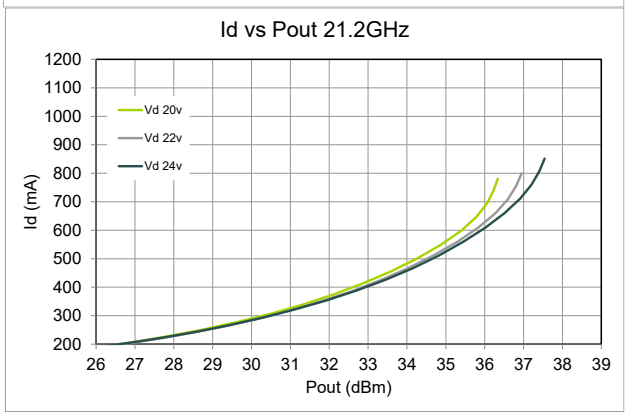



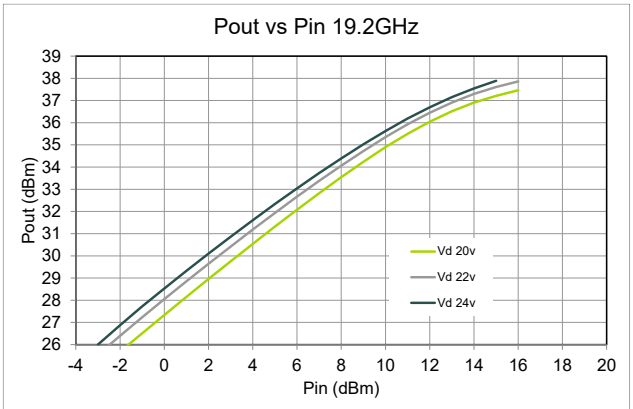
**Power Performance**| Test Conditions unless otherwise stated | $V_D$=20V, 22V 24V, $I_D$=84mA, $T_A$=25°C, CW

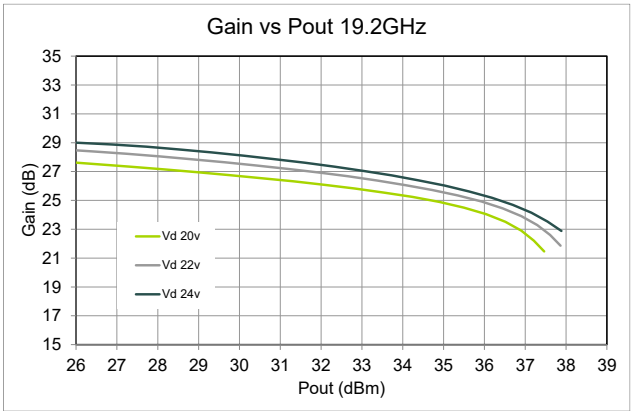


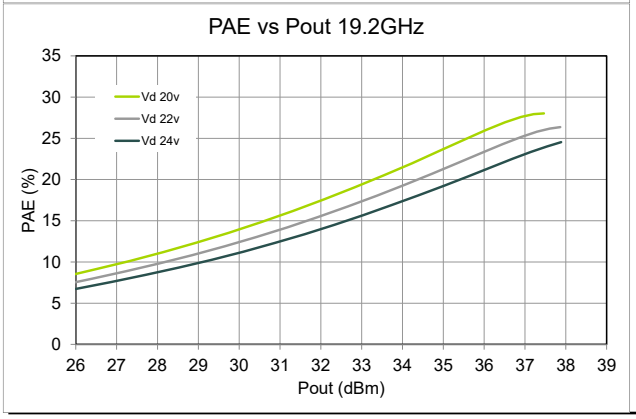



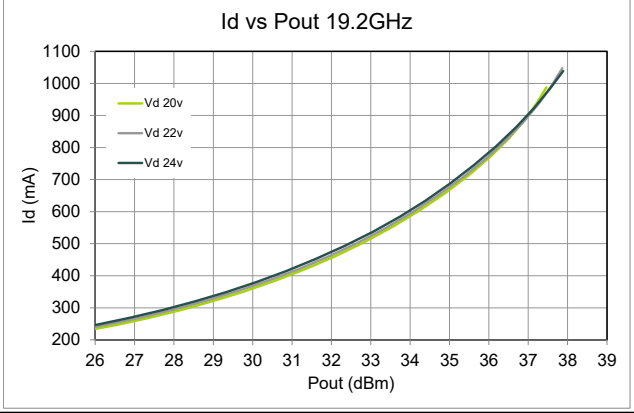



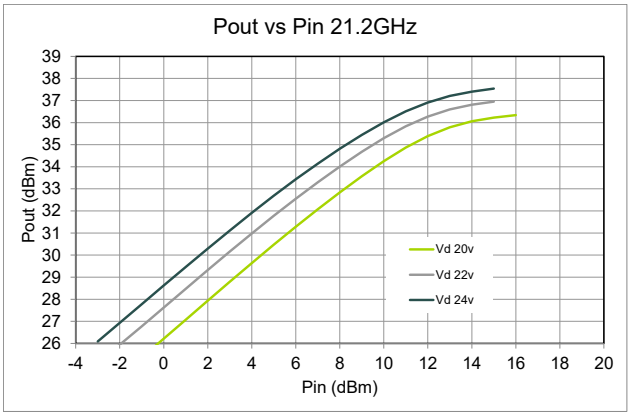



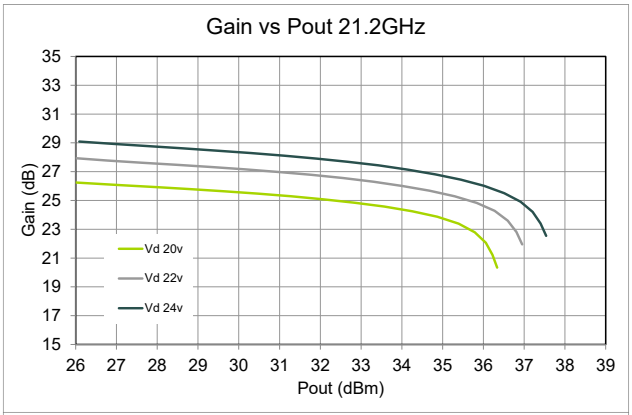



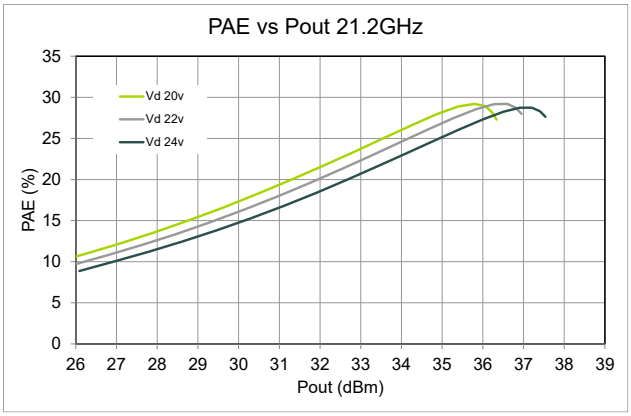



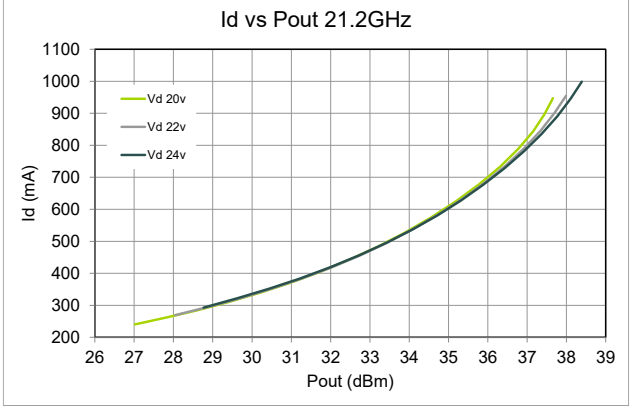



## Power Performance | Test Conditions unless otherwise stated | $V_D$=20V, 22V 24V, $I_D$=84mA, $T_A$=25°C, CW

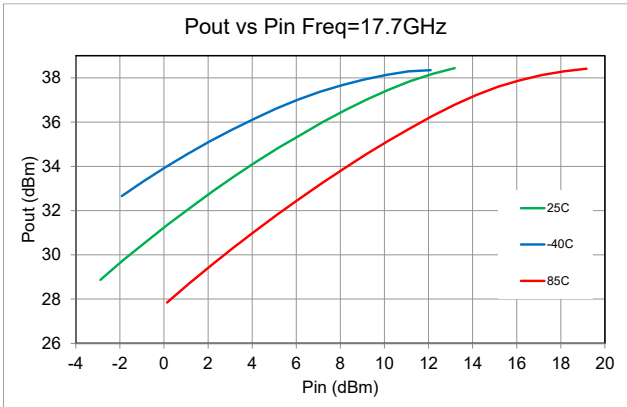


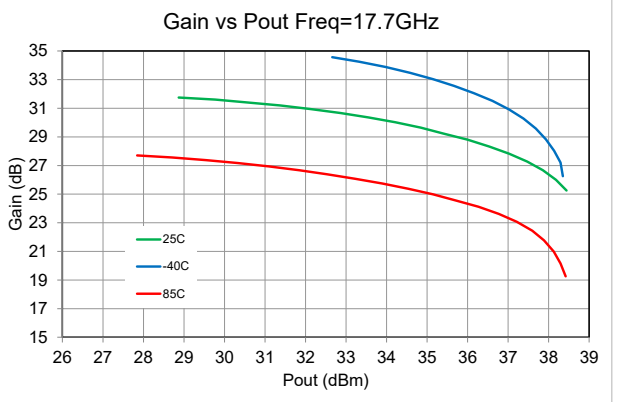



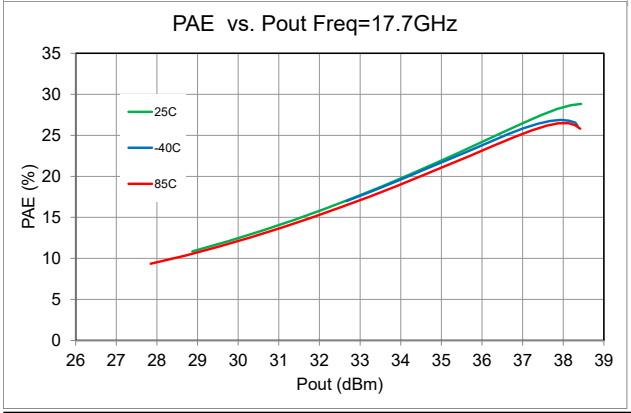



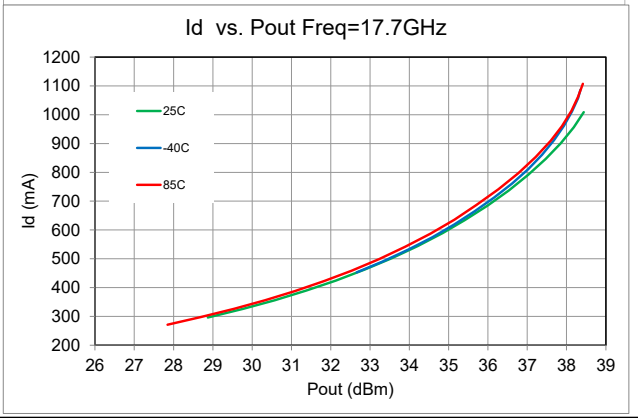




## Power Performance | Test Conditions unless otherwise stated | $V_D$=24V, $I_D$=84mA, CW Temperature=-40°C, +25°C, +85°C



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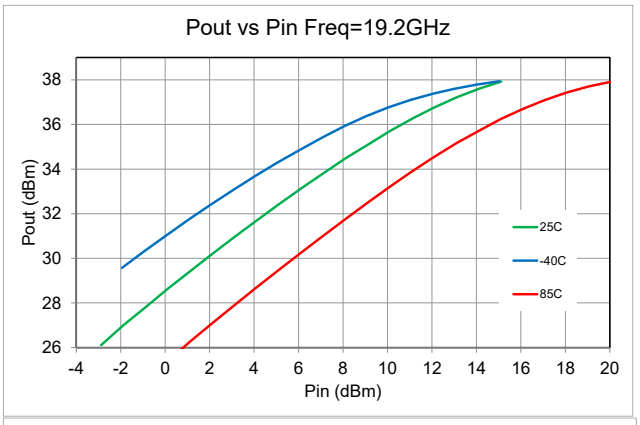
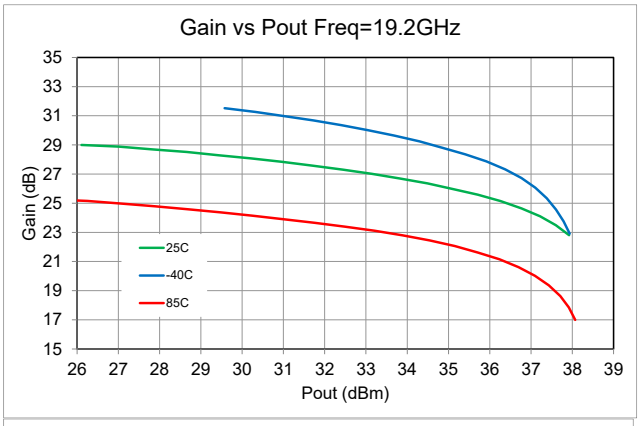
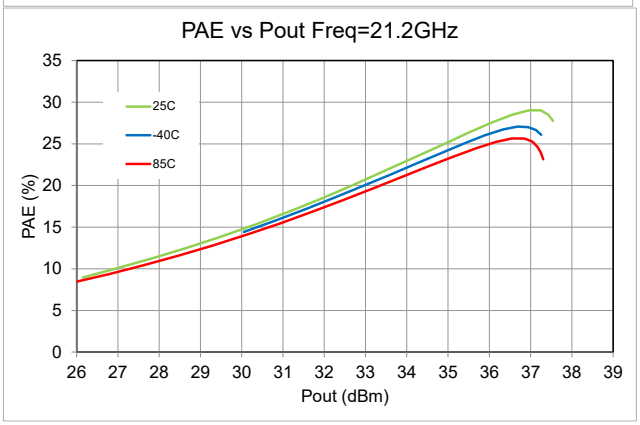
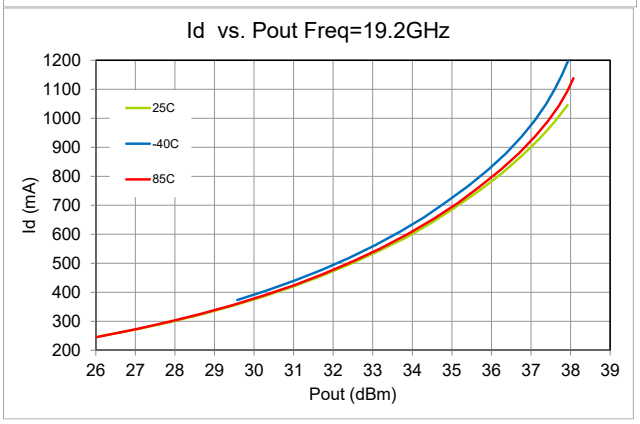
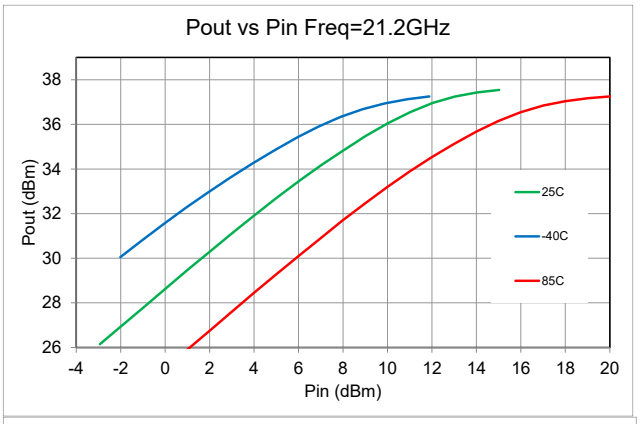
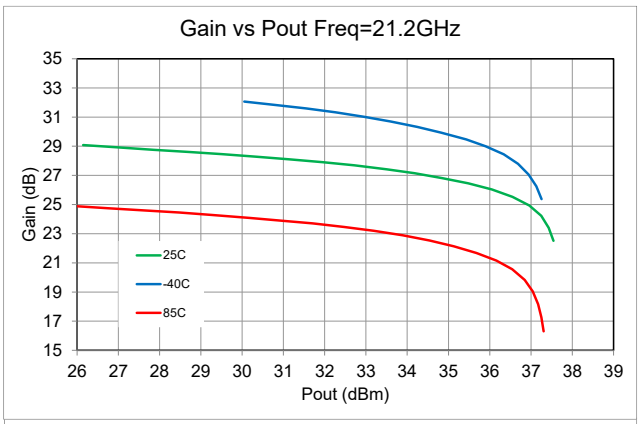


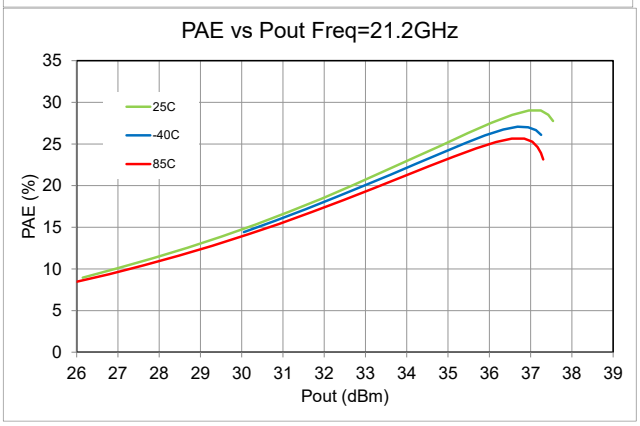



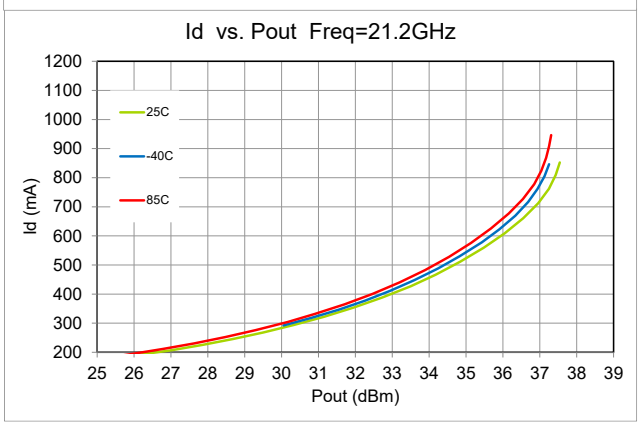



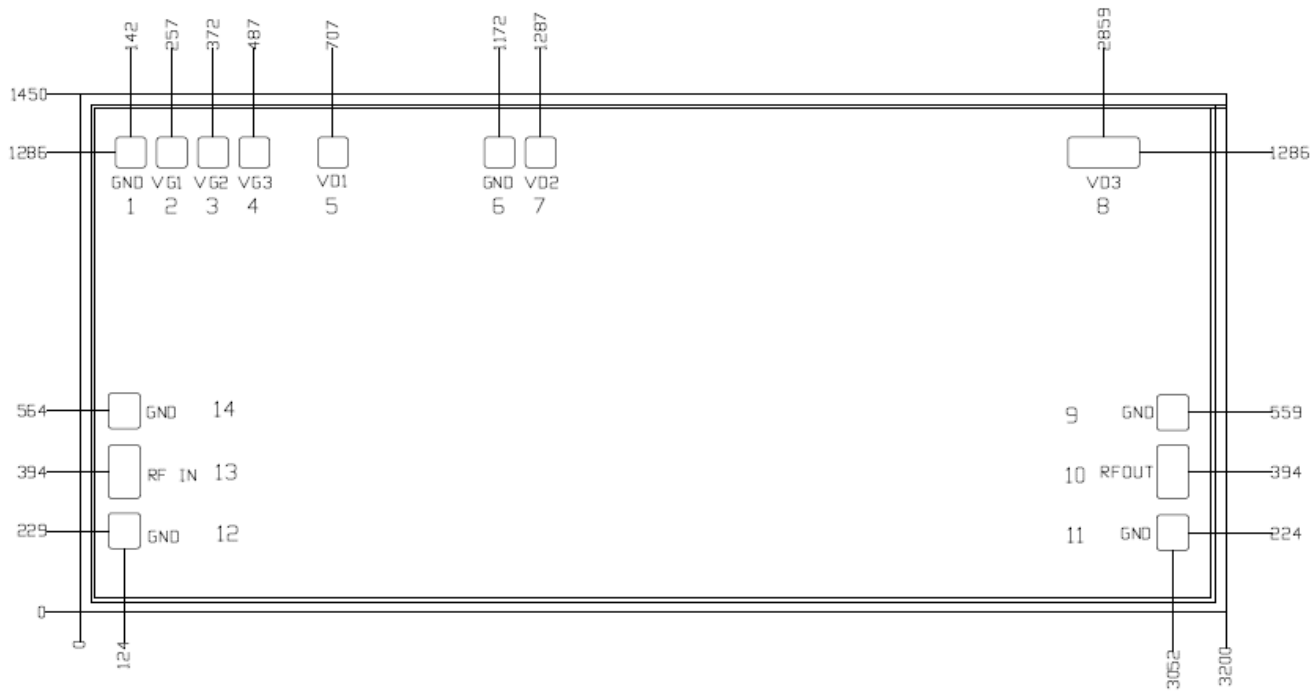



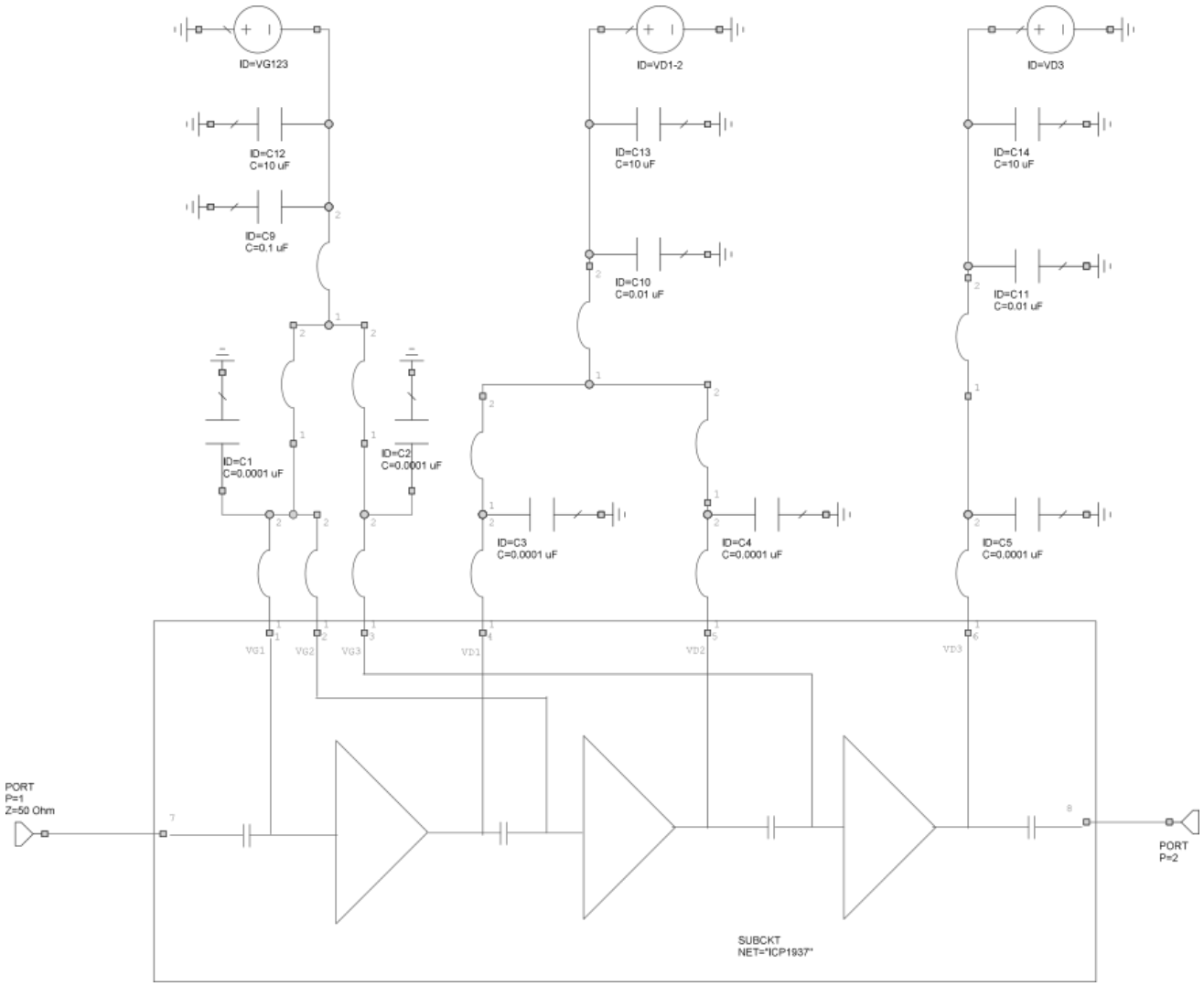
## Mechanical Drawing




Units: µm
Thickness: 100µm
Backside of Chip is RF and DC ground

| Pad No | Pad Size (um) | Function | Description |
|---|---|---|---|
| 1 | 89 x 150 | GND | Ground |
| 2 | 85 x 85 | VG1 | First stage gate bias, decoupling and bypass caps required |
| 3 | 85 x 85 | VG2 | Second stage gate bias, decoupling and bypass caps required |
| 4 | 85 x 85 | VG3 | Third stage gate bias, decoupling and bypass caps required |
| 5 | 85 x 85 | VD1 | First stage drain voltage, decoupling and bypass caps required |
| 6 | 89 x 150 | GND | Ground |
| 7 | 85 x 85 | VD2 | Second stage drain voltage, decoupling and bypass caps required |
| 8 | 200 x 85 | VD3 | Third stage drain voltage, decoupling and bypass caps required |
| 9,11,12,14 | 89 x 100 | GND | Ground Pads |
| 10 | 89 x 150 | RF OUT | RF Output |
| 13 | 89 x 150 | RF IN | RF Input |

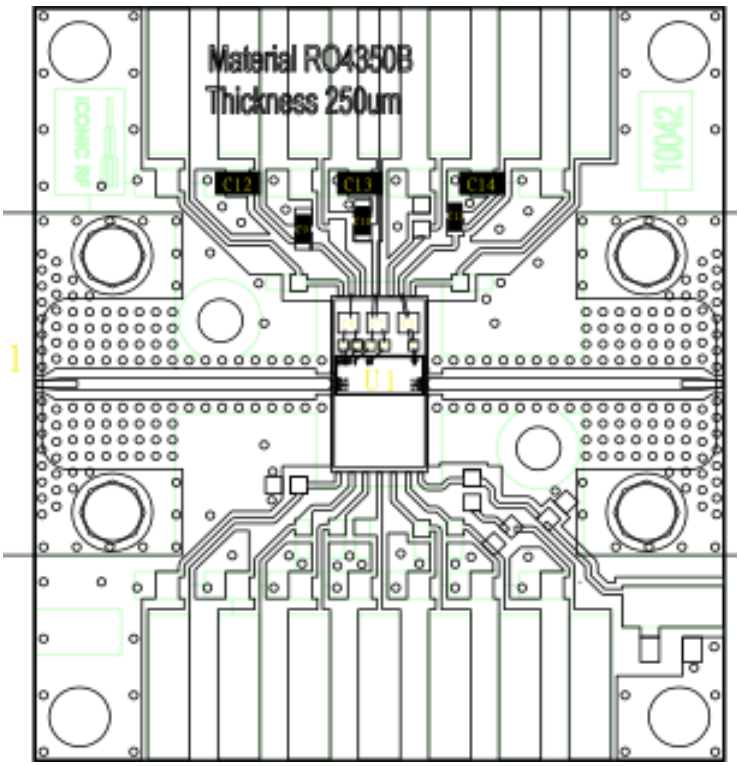
### Application Circuit

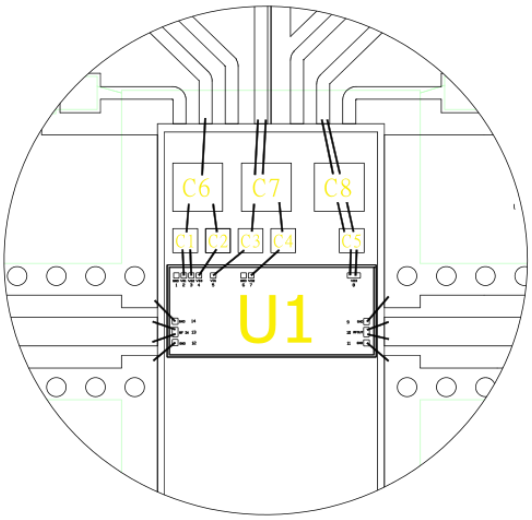



### Bill of Materials

| Assembly Reference | Value | Description | Manufacturer Part No. |
|---|---|---|---|
| U1 | | ICP1937 MMIC | ICP1937 |
| C1-C5 | 100pF | SLC Capacitor | Johanson 500U01A101MT4W |
| C6-C8 | 10000pF | SLC Capacitor | Knowles V30BZ103M1SX |
| C9 | 100nF | 0402 size Capacitors | Various |
| C10,C11 | 10nF | 0402 size Capacitors | Various |
| C12-C14 | 10uF | 0603 size Capacitors | Various |

**Assembly Drawing**




DETAIL A - BONDING
SCALE 5 : 1

## Assembly Guidance

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

### Interconnect assembly Notes

- 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.

### Die attach of component using adhesive

- 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:-
  - Namics H9889–1

### Reflow Process

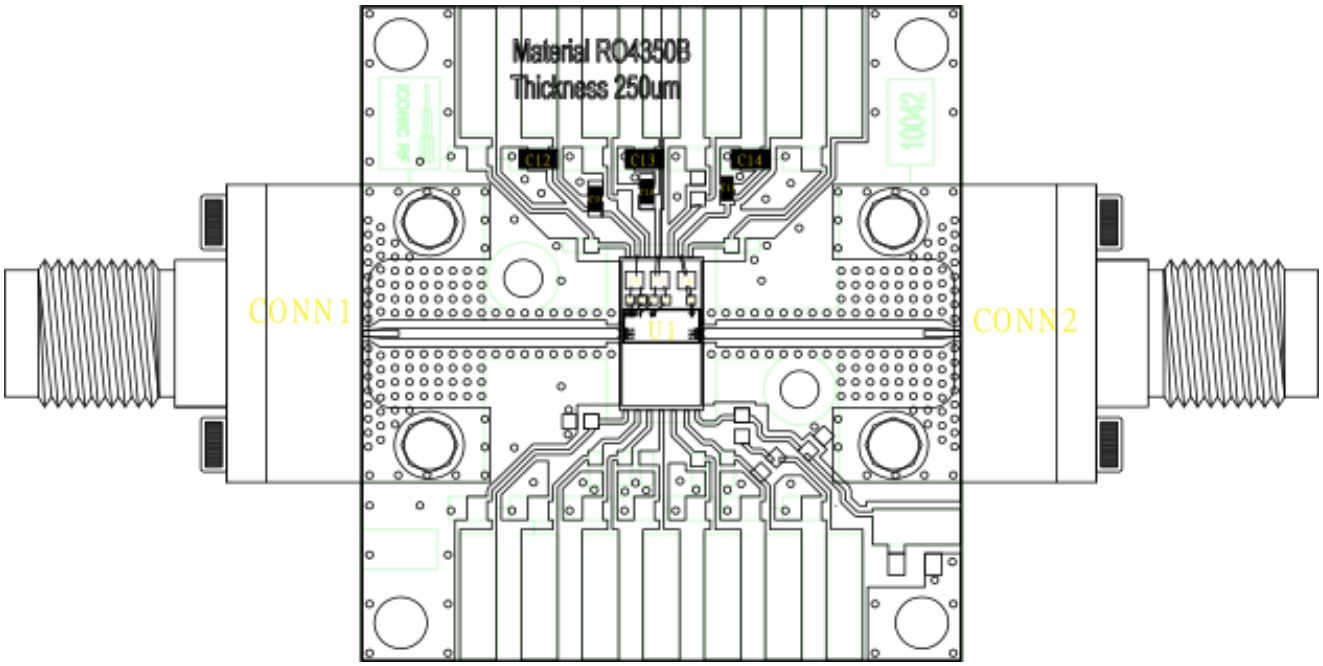
- Maximum temperature 320°C for 30 seconds.
- Material matching for coefficient of thermal expansion is crucial for long-term reliability

## Assembly Guidance continued:

For optimum RF and thermal performance Microchip Technology 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 170µm thick) for optimal heat transfer.

There are many variables of the second level assembly between the die base plate and heat sink that Microchip Technology is unable to control, and the following guidance is provided for information only. Fixing bolts should be provided as close to the die as possible to ensure an 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 2.5 N/m.




## Bias-Up Procedure

1. Set $V_G$= -5V
2. Set $V_D$ to 20-24V
3. Adjust $V_G$ positive until $I_D$ quiescent is 84mA
4. Limit $I_D$ to 1.5A
5. Apply RF Signal

## Bias-down Procedure

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

## Handling Procedures

Please observe the following precautions to avoid damage:

## Static Sensitivity

Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices. Class 1A HBM (250-500V) ESD Classification is anticipated.