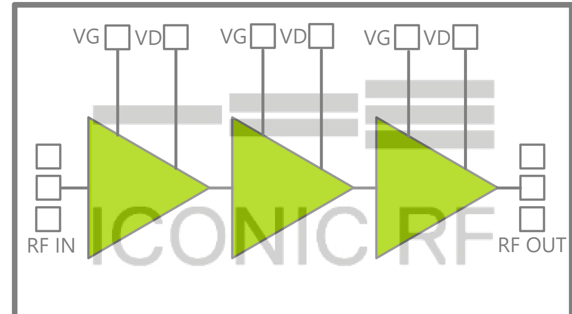
Features

- Frequency Range: 17-21GHz
- Pout: 40 dBm @ 21dBm Pin
- PAE: 32 %
- Small Signal Gain: 28dB
- Bias: VD=24V IDQ=168mA
- Technology: GaN on SiC
- Lead-free and RoHS compliant
- Die Size = 3.2mm x 2.6 mm
- Unconditionally Stable

Functional Diagram



Applications

Description

ICONICRF's ICP1940 is a three stage MMIC power amplifier in bare die form, fabricated using GaN on SiC technology. The PA operates from 17-21GHz with 40dBm output power, 32% PAE and 28dB small signal gain. The die has integrated DC blocking capacitors and is matched to 50ohms on the RF input and output ports. The operating frequency provides flexible operation for a variety of applications including Satellite and Point to Point Radio. The ICP1940 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=*168mA*, *TA*=25 °C, CW

Parameter	Conditions	Min	Typ	Max	Units
Frequency		17.7		21.2	GHz
Output Power @ P_{sat}	Pin=21dBm		40		dBm
PAE @ P_{sat}	Pin=21dBm	28	30		%
IM3	Pout =36dBm		-25		dBc
Small Signal Gain			24		dB
Input Return Loss			18		dB
Output Return Loss			10		dB
I_{DQ}			168		mA
V_{GS}			-1.85		V
ID drive	Pout 40dBm		1800		mA

Absolute Maximum Ratings

Parameter	Absolute Maximum
Drain Voltage (V_D)	30.0V
Gate Voltage Range (V_G)	-5 to 0V
Gate Current (IG)	10mA
Drain Current (CW) T_A=25ºC	2.9A
Power Dissipation (CW) T_A=25ºC Power Dissipation (CW) T_A=85ºC	70W 49W
CW Input Power 50ohm, T_A=25ºC	+30dBm
Channel Temperature	275°C
Storage Temperature	-65°C to +150°C
Input Power VSWR (2:1), V_D=20V, I_{DQ}=168mA V_D=24V, I_{DQ}=168mA	 +26dBm +26dBm
Eutectic Die Attach Temperature (30s)	320°C

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

Thermal and Reliability

Parameter	Value
Thermal Resistance	2.8 C/W

Notes

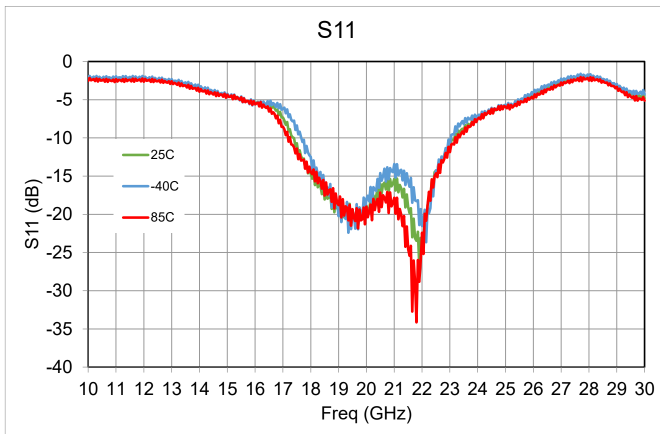
1. Assumes silver sintered epoxy attach (15um thick) mounted on CuMo carrier.
2. Base temperature is assumed at the top of the CuMo carrier
3. Thermal resistance calculated using IR measurement of the channel temperature.

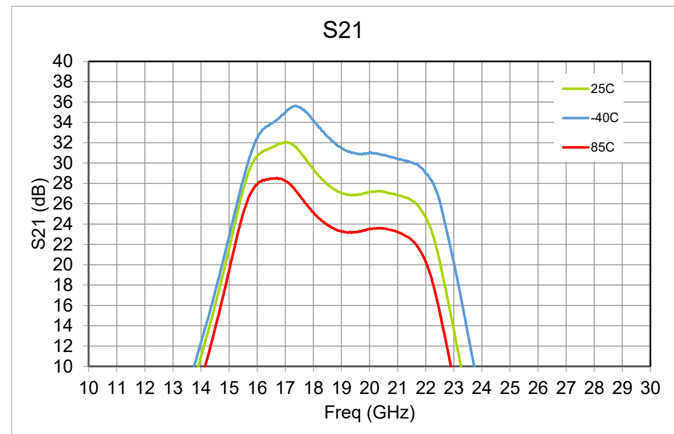
Ordering Information

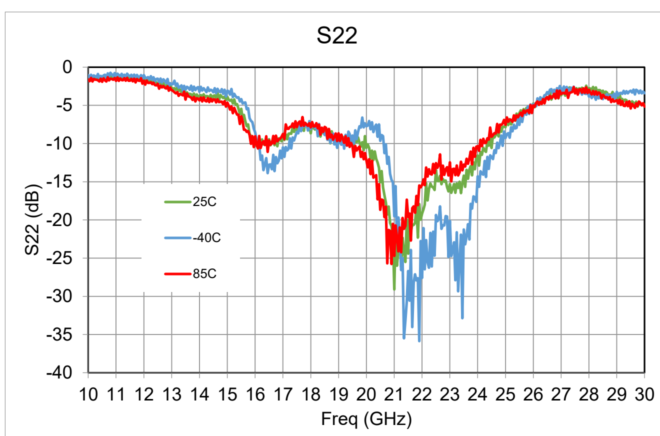
Part No.	Description
ICP1940-1-110I	Bare die
ICP1940-1-501U	Evaluation Board with SMA connectors

Typical Performance

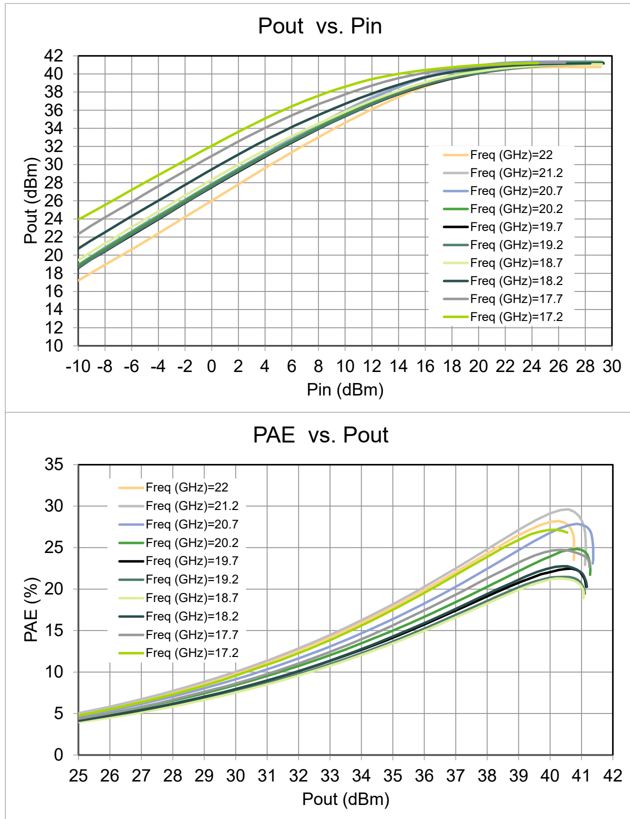
S-Parameter Performance | Test Conditions unless otherwise stated | V_D=*24V*, T_A=*-40°C, 25ºC, +85ºC*, I_D=*168mA*

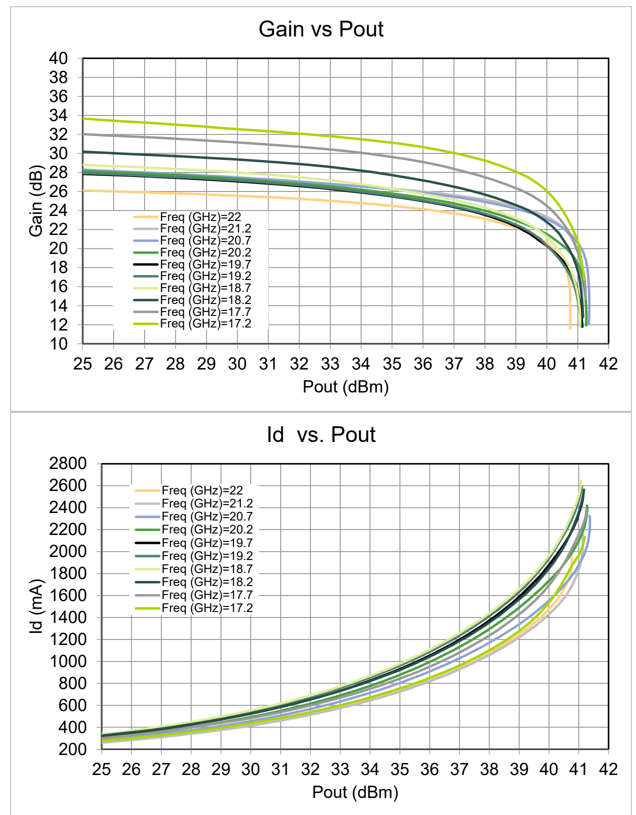




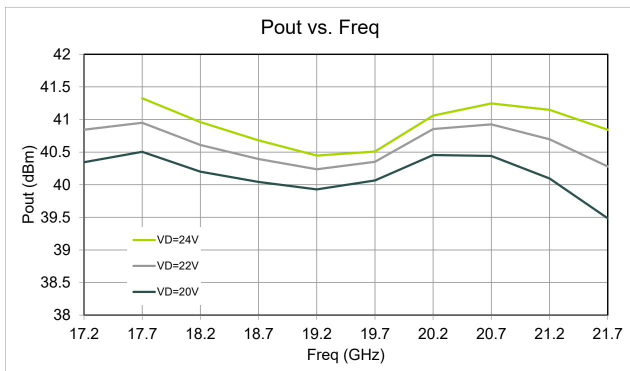


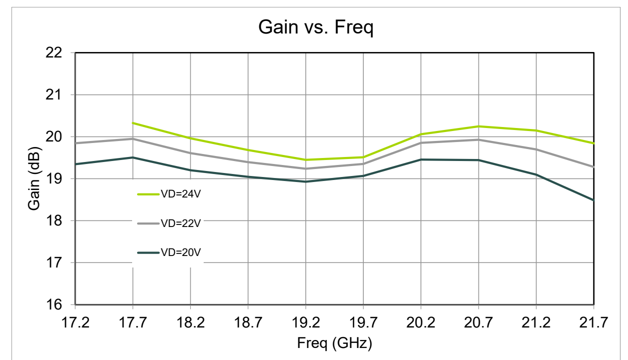
Power Performance | Test Conditions unless otherwise stated | V_D=24V, I_D=168mA, T_A=25°C, CW

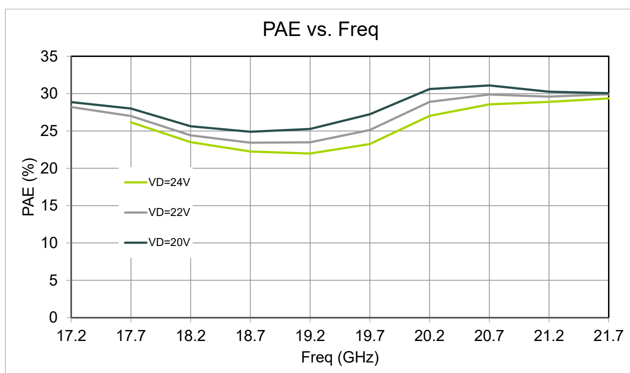


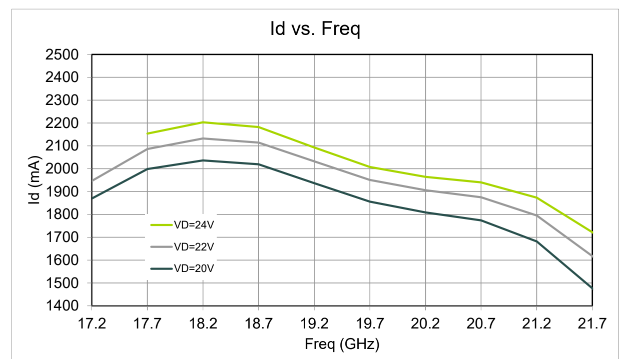


Power Performance vs Frequency | Test Conditions unless otherwise stated | Pin=21dBm I_D=168mA, T_A=25°C, CW

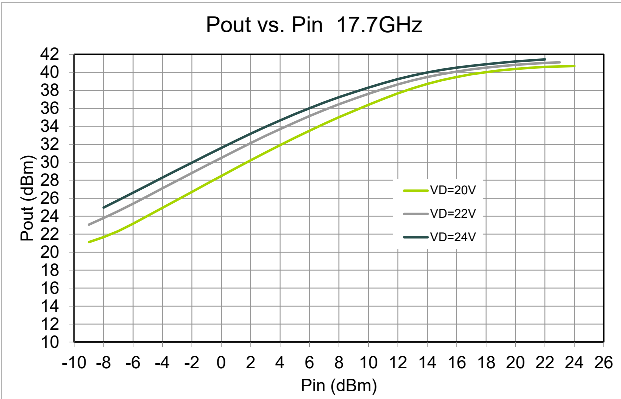


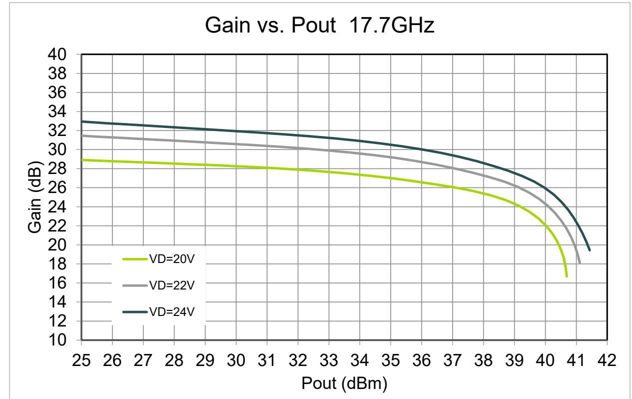


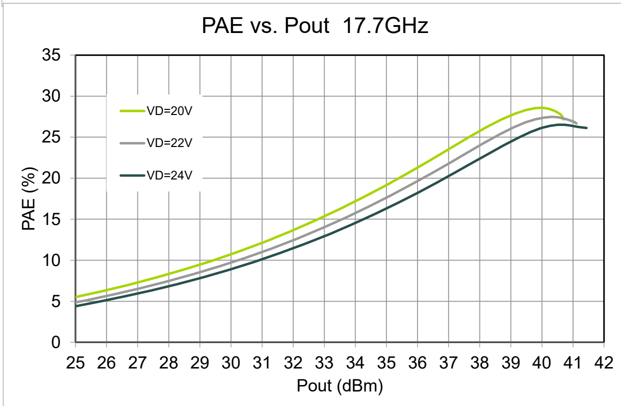


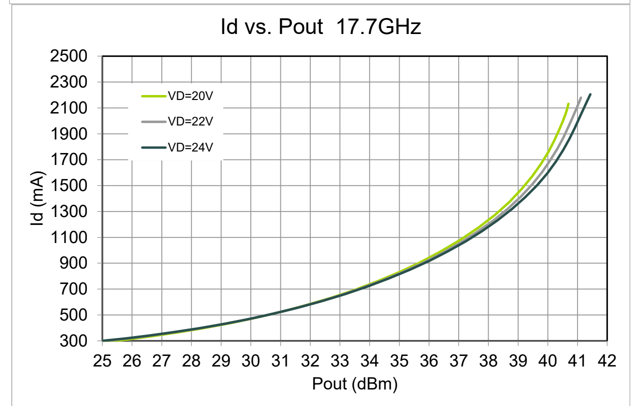


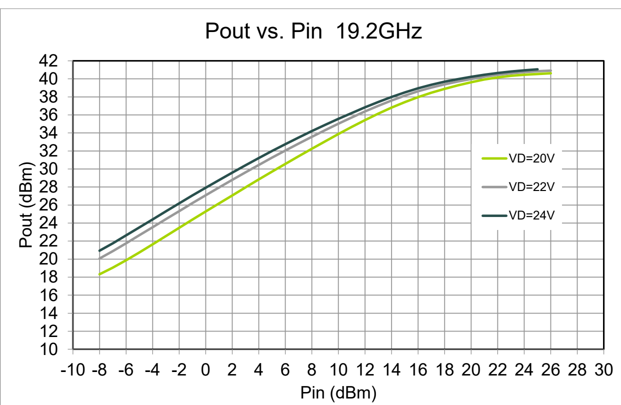
Power Performance| Test Conditions unless otherwise stated | V_D=20V, 22V 24V, I_D=168mA, T_A=25ºC, CW

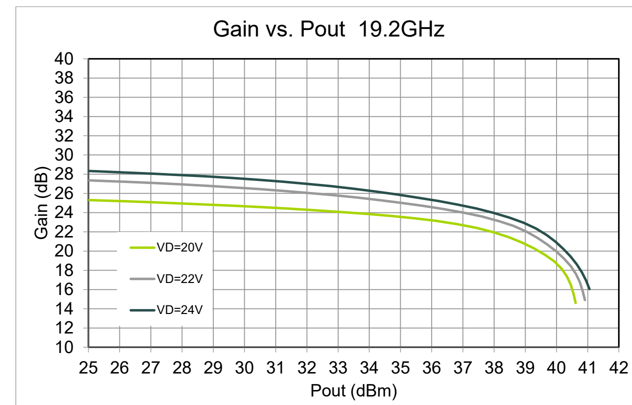


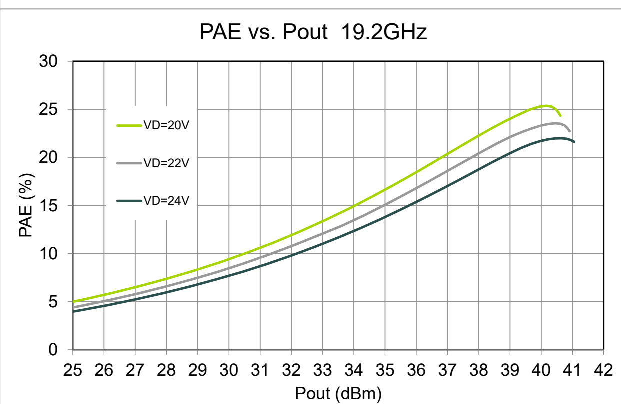


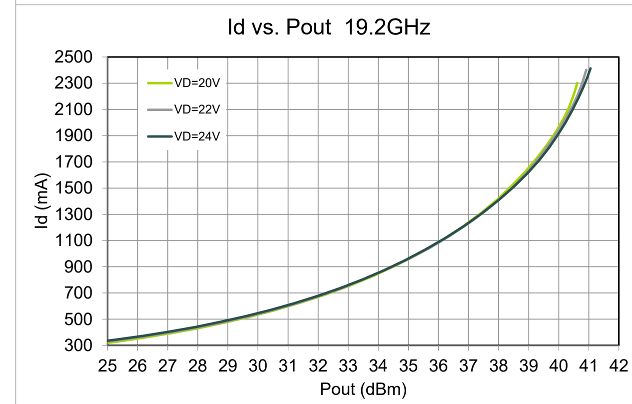




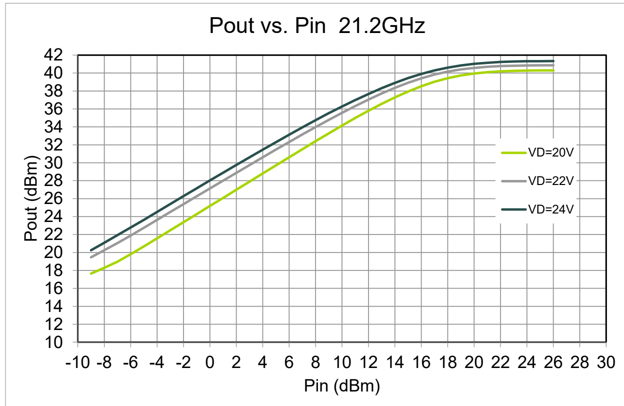


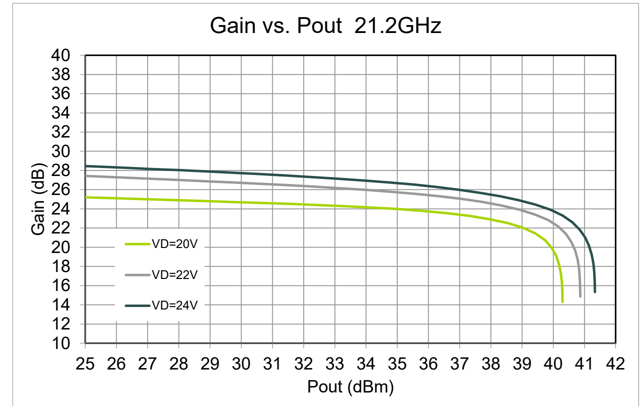


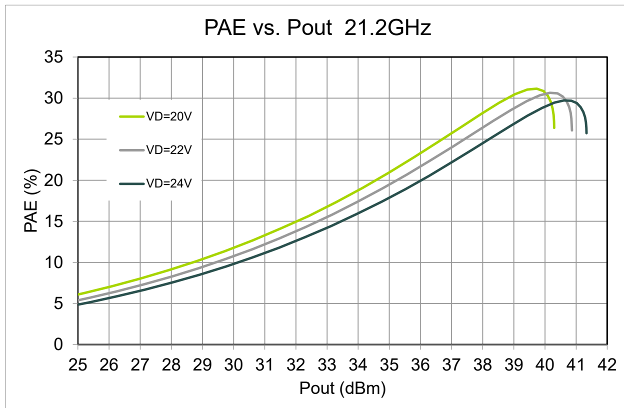


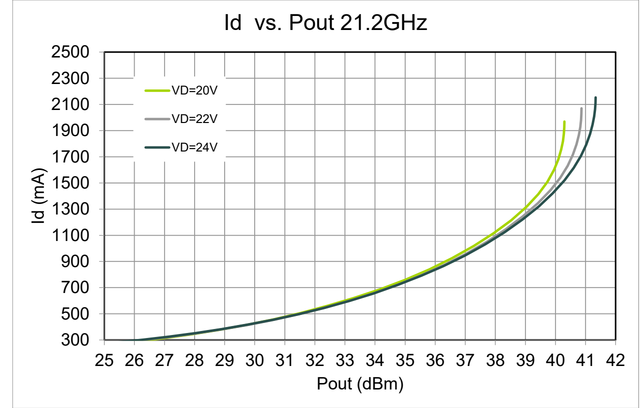


Power Performance | Test Conditions unless otherwise stated | V_D=20V, 22V 24V, I_D=168mA, T_A=25ºC, CW

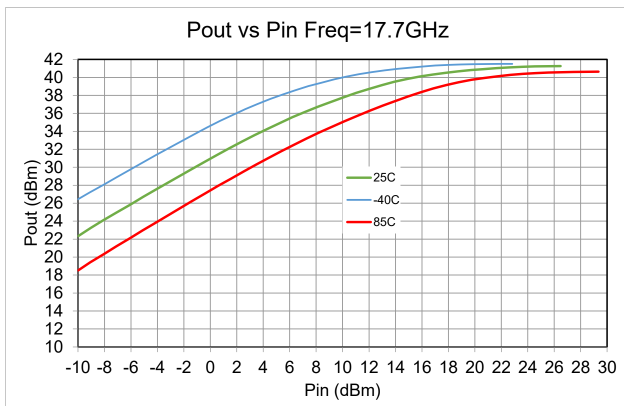


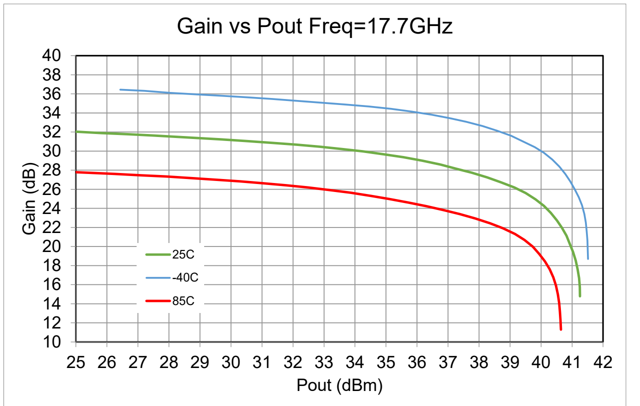


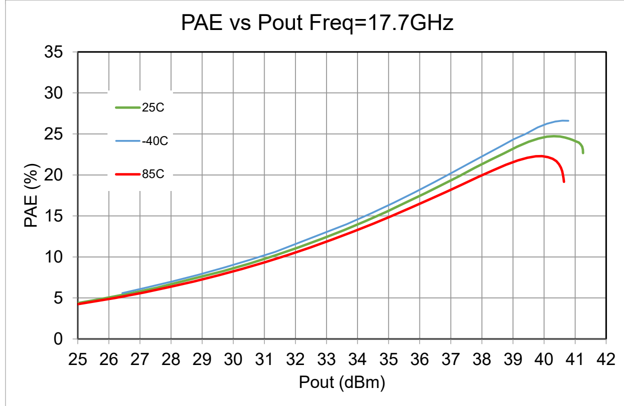


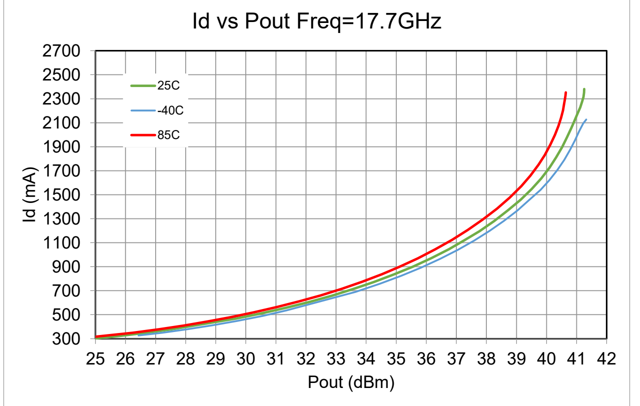


Power Performance | Test Conditions unless otherwise stated | V_D=24V, I_D=168mA, CW Temperature=-40°C, +25°C, +85°C

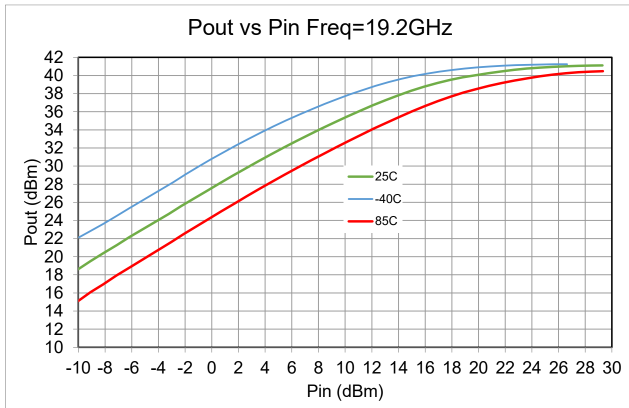


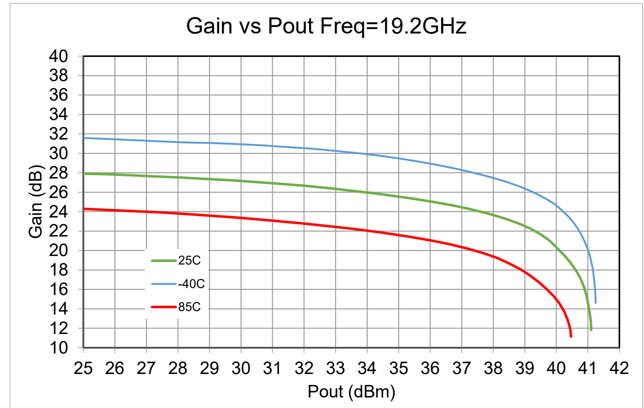


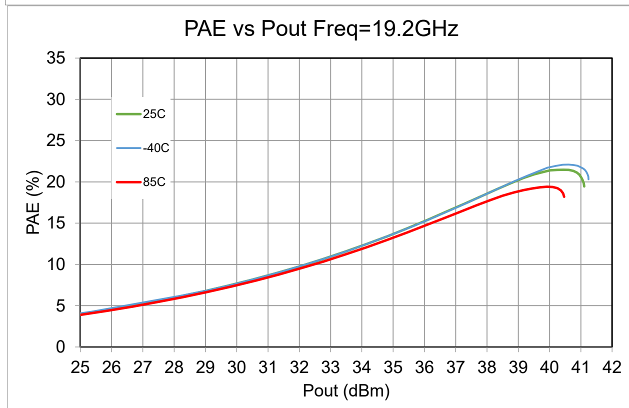


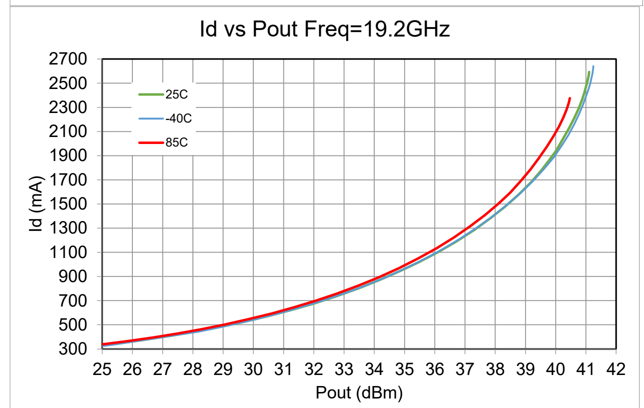


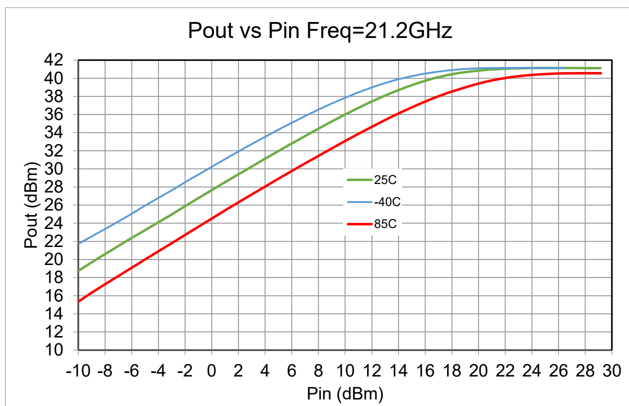
Power Performance | Test Conditions unless otherwise stated | V_D=24V, I_D=168mA, CW Temperature=-40°C, +25°C, +85°C

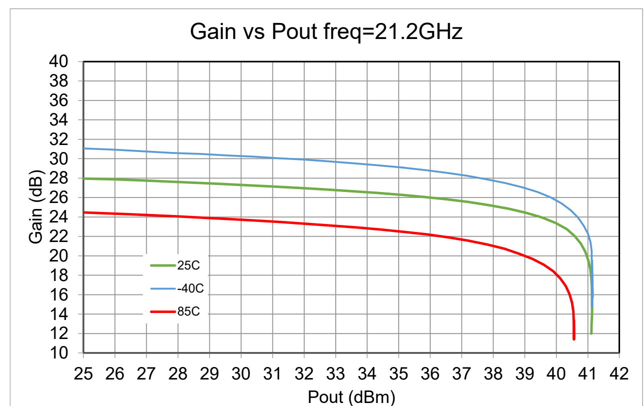


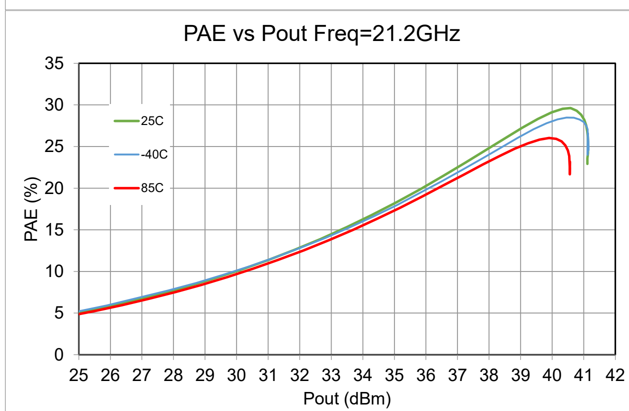


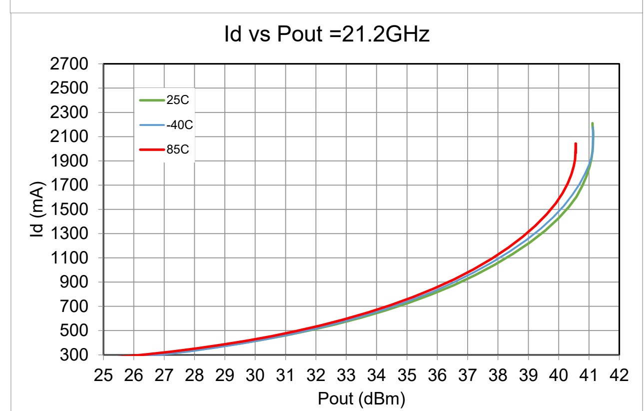




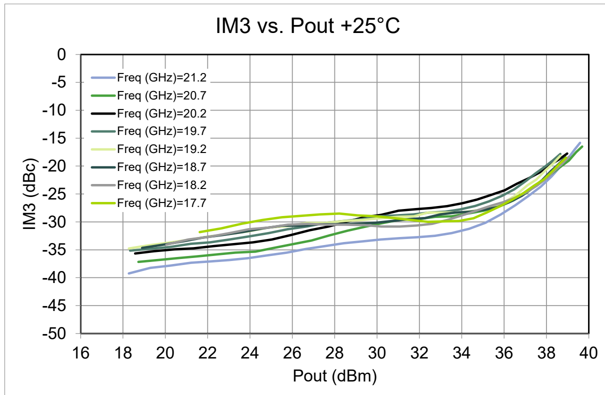


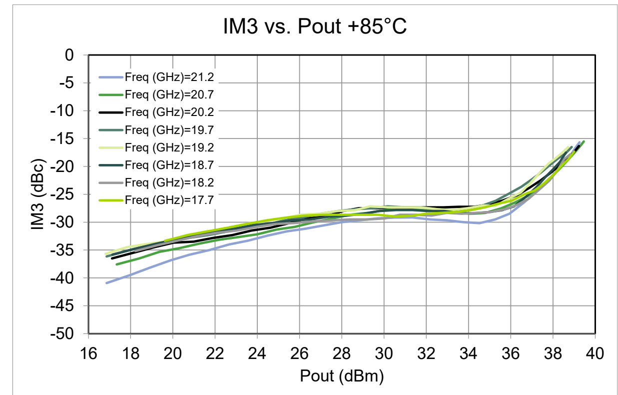


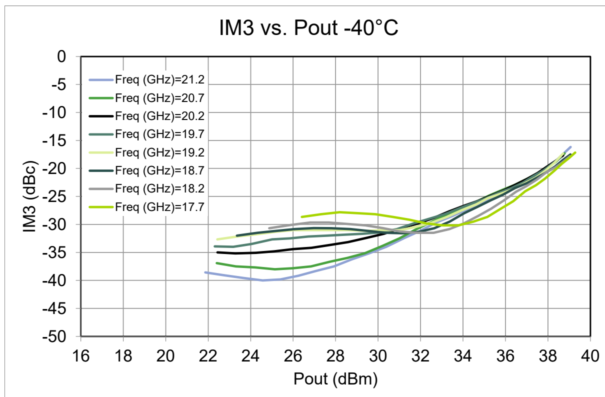




Linear Performance | Test Conditions unless otherwise stated | V_D=*24V,* I_{DQ}=*168mA, CW,* Tone Spacing 10MHz

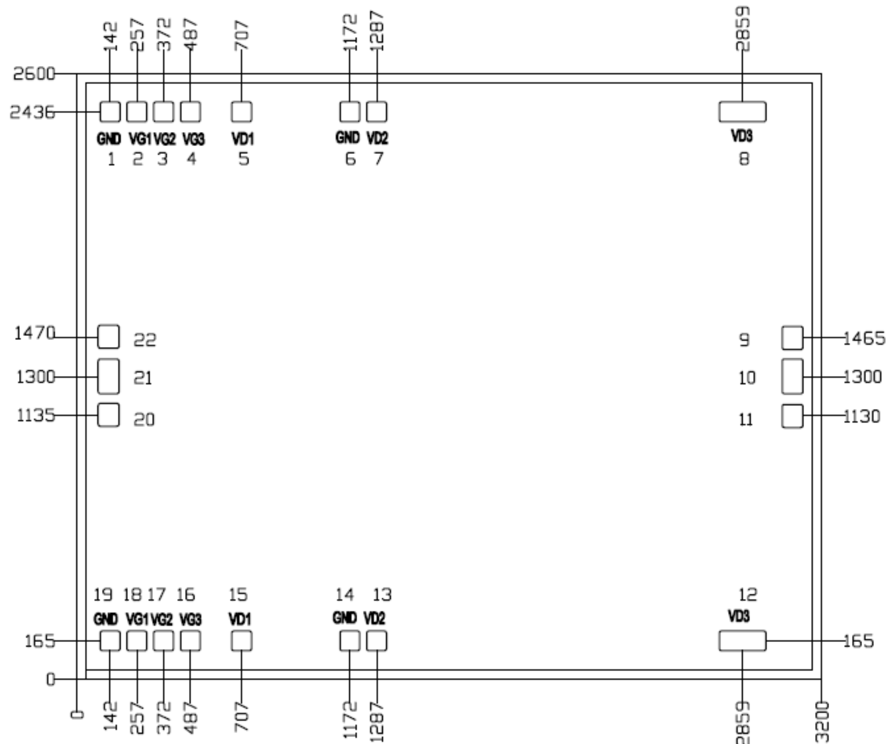






Output Power is sum of two carrier tones.

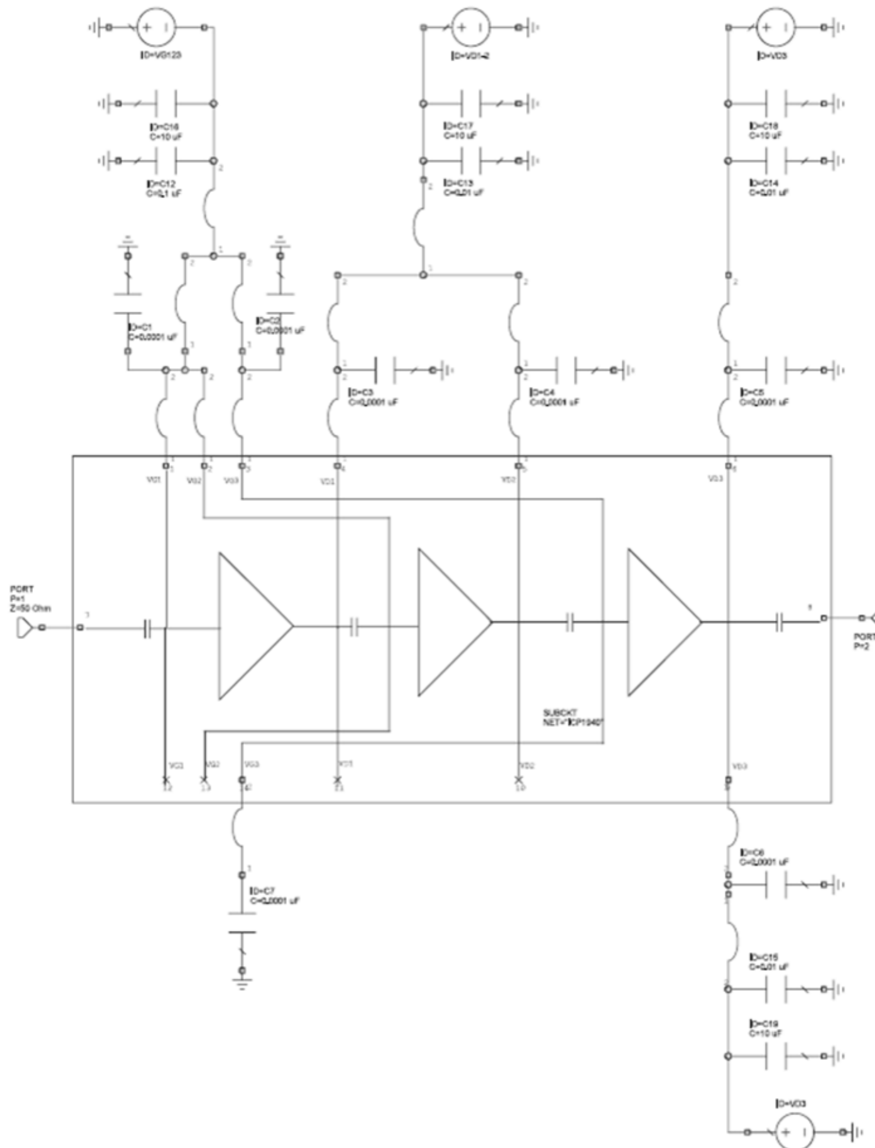
Mechanical Drawing



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

Pad No	Pad Size (um)	Function	Description
1, 19	89x150	GND	Ground
2, 18	85x85	VG1	First stage gate bias, decoupling and bypass caps required
3, 17	85x85	VG2	Second stage gate bias, decoupling and bypass caps required
4, 16	85x85	VG3	Third stage gate bias, decoupling and bypass caps required
5, 15	85x85	VD1	First stage drain voltage, decoupling and bypass caps required
6, 14	89x150	GND	Ground
7, 13	85x85	VD2	Second stage drain voltage, decoupling and bypass caps required
8, 12	200x85	VD3	Third stage drain voltage, decoupling and bypass caps required
9,11,20,22	89x100	GND	Ground Pads
10	89x150	RF OUT	RF Output
21	89x150	RF IN	RF Input

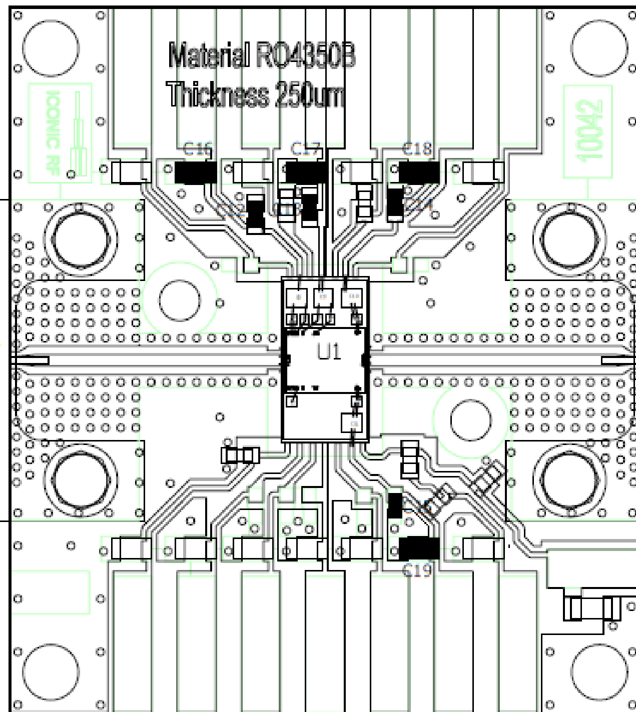
Application Circuit

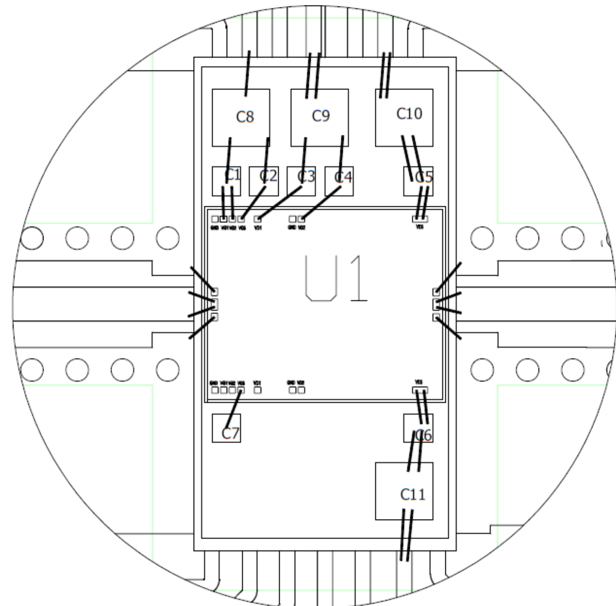


Bill of Materials

Assembly Reference	Value	Description	Manufacturer Part No.
U1		ICP1940 MMIC	ICP1940
C1-C7	100pF	SLC Capacitor	Johanson 500U01A101MT4W
C8-C11	10000pF	SLC Capacitor	Knowles V30BZ103M1SX
C12	100nF	0402 size Capacitors	Various
C13,C15	10nF	0402 size Capacitors	Various
C16-C19	10uF	0603 size Capacitors	Various

Assembly Drawing





Assembly Guidance

Optimum RF power performance 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
  - Kyocera CT2700R7S

Die attach using Eutectic

- Flux-less gold-tin (AuSn) (80% Au, 20% Sn with a melting point of 280ºC) 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 310ºC 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.

Reflow Process

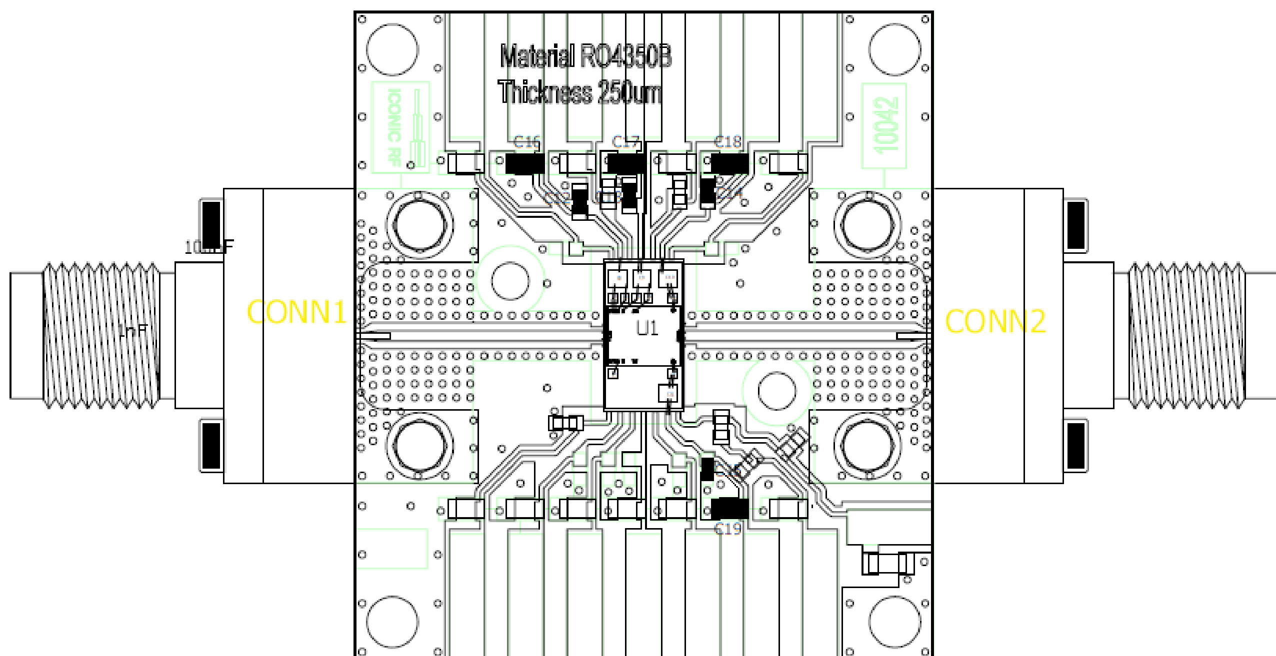
- Maximum temperature 320ºC for 30 seconds.
- Material matching for coefficient of thermal expansion is crucial for long-term reliability

Assembly Guidance continued.

For optimum RF and thermal performance IconicRF recommends the die assembly base plate is adequately bolted to a 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 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=-5V
2. Set V_D to 20-24V
3. Adjust V_G positive until I_D quiescent is 168mA
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.

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