



Description

ICONICRF's ICP1240 is a 3 stage MMIC power amplifier in bare die form, fabricated using GaN on SiC technology. ICP1240 operates from 6-18GHz with 41 dBm output power, >18% PAE and 23dB typical small signal gain. ICP1240 is well suited to a variety of commercial, aerospace and defense applications.

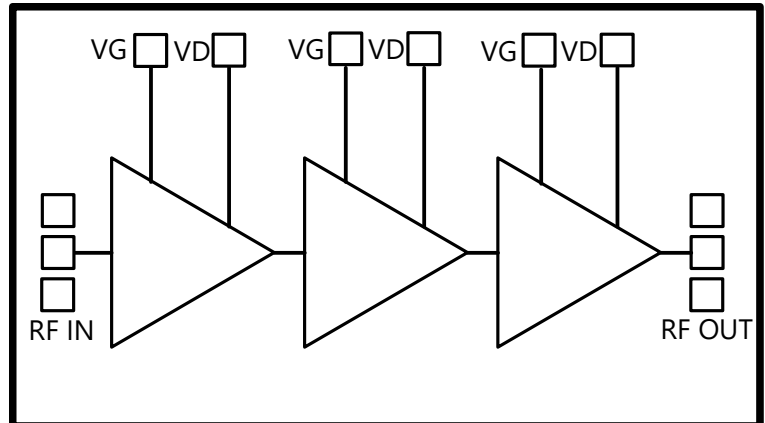
Features

- Frequency Range: 6-18GHz
- Pout: 41 dBm @ 24dBm Pin
- Typical PAE: 22 %
- Small Signal Gain: 23dB
- Bias: $V_D=20V$ $I_{DQ}=1500mA$, Typical $V_G=-1.6V$
- Technology: GaN on SiC
- Lead-free and RoHS compliant
- Die Size = 5.15 mm x 3.15 mm

Applications

- Test and Measurement
- Aerospace & Defense

Functional Block Diagram



Electrical Specifications | Test Conditions unless otherwise stated | $V_D=24V$, $I_D=280mA$, $TA=25^\circ C$, CW

Parameter	Conditions	Min	Typ	Max	Units
Frequency		6		18	GHz
Output Power @ P_{sat}	Pin=24dBm		41		dBm
PAE @ P_{sat}	Pin=24dBm		22		%
Small Signal Gain			23		dB
Input Return Loss			15		dB
Output Return Loss			7		dB



Absolute Maximum Ratings

Parameter	Absolute Maximum
Drain Voltage (V_D)	30.0V
Gate Voltage Range (V_G)	-5 to 0V
Gate Current (I_G)	14mA
Drain Current (CW) $T_A=25^\circ\text{C}$	6.0A
Power Dissipation (CW) $T_A=25^\circ\text{C}$ Power Dissipation (CW) $T_A=85^\circ\text{C}$	140W 110W
CW Input Power 50ohm, $T_A=25^\circ\text{C}$	+29dBm
Channel Temperature	275°C
Storage Temperature	-65°C to +150°C
Input Power VSWR (2:1), $V_D=20\text{V}$, $I_{DQ}=280\text{mA}$ $V_D=24\text{V}$, $I_{DQ}=280\text{mA}$	27dBm
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	1.71°C/W

Notes

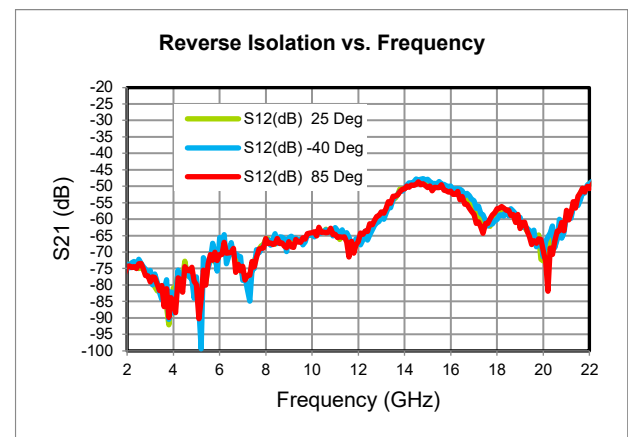
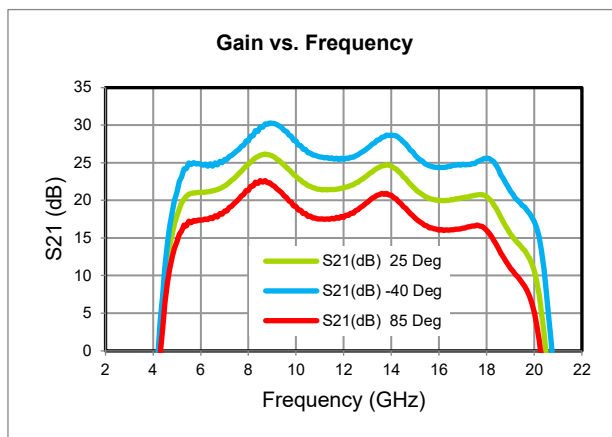
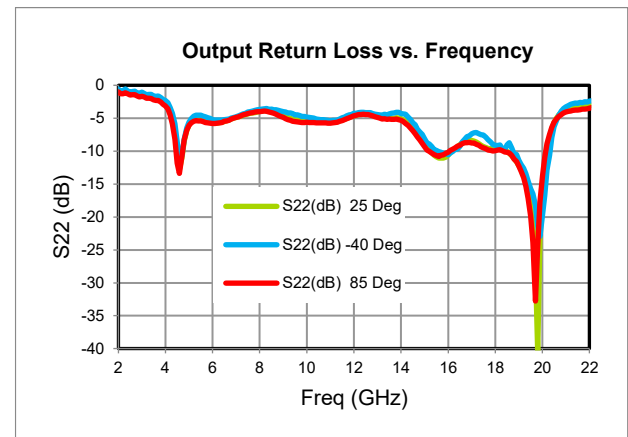
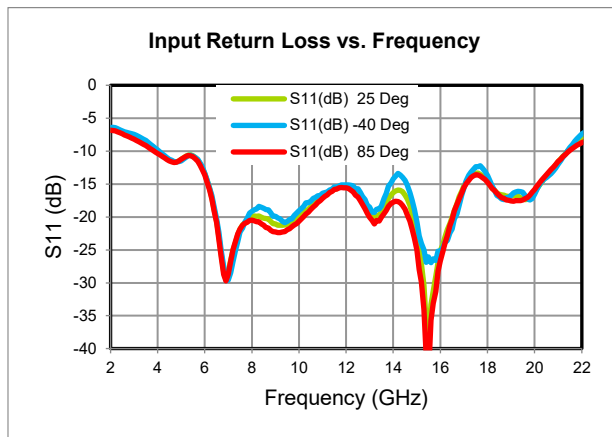
- Assumes silver sintered epoxy attach (15um thick) mounted on CuMo carrier.
- Base temperature is assumed at the top of the CuMo carrier
- Thermal resistance calculated using IR measurement of the channel temperature.

Ordering Information

Part No.	Description
ICP1240-1-110I	Bare die in Gel-Pack trays
ICP1240-1-501U	Evaluation Board with SMA connectors

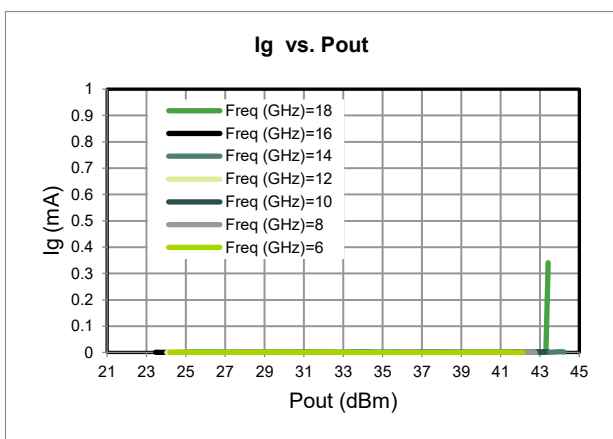
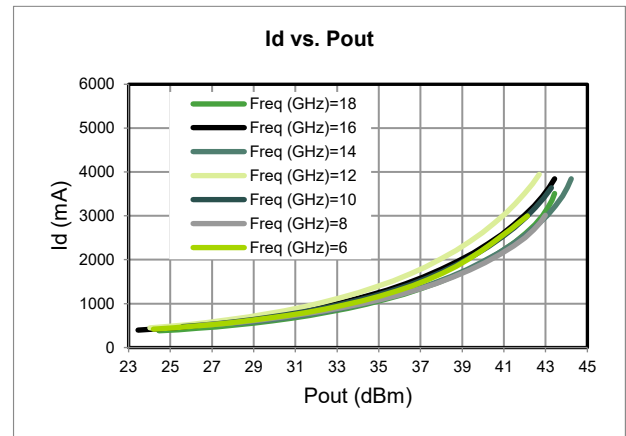
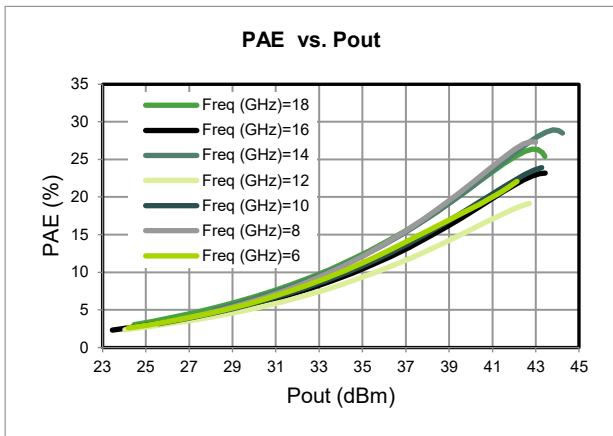
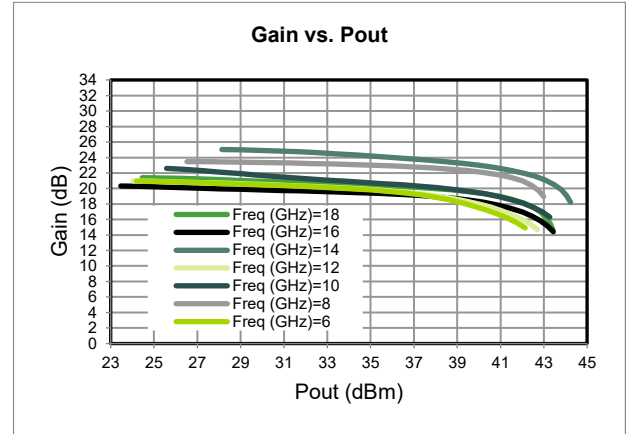
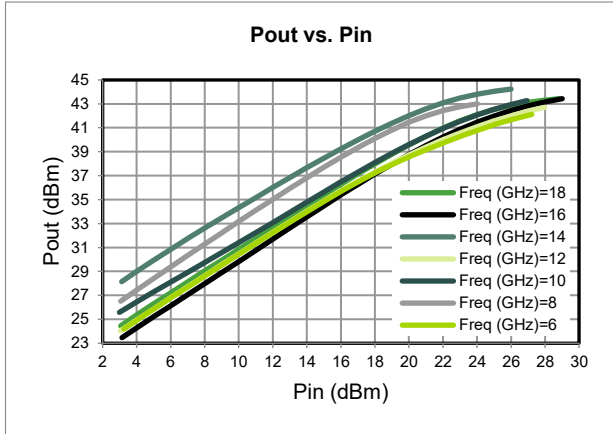
Performance Data

Typical Small Signal Data | Test conditions unless otherwise stated $V_D=24\text{V}$, $I_{DQ}=280\text{mA}$, $T_A=25^\circ\text{C}$, CW



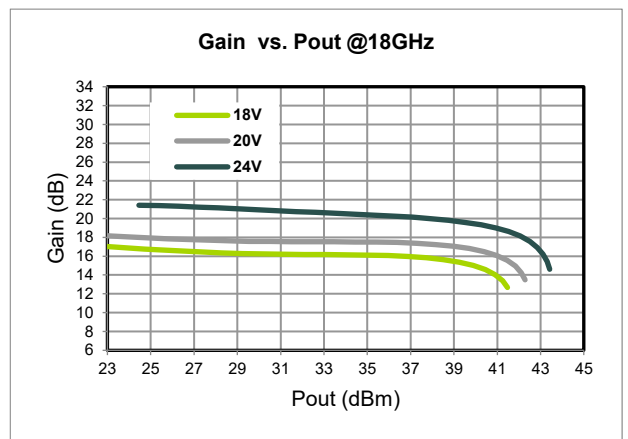
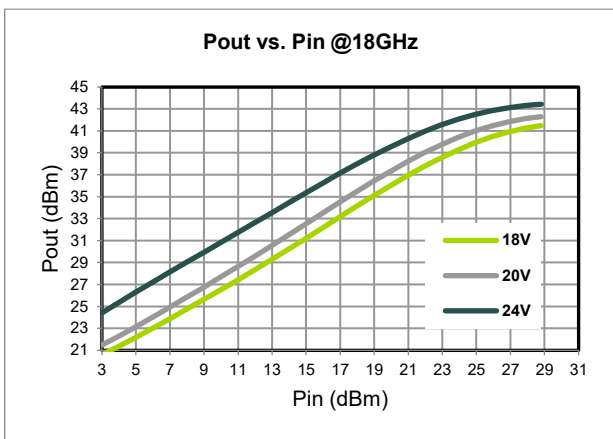
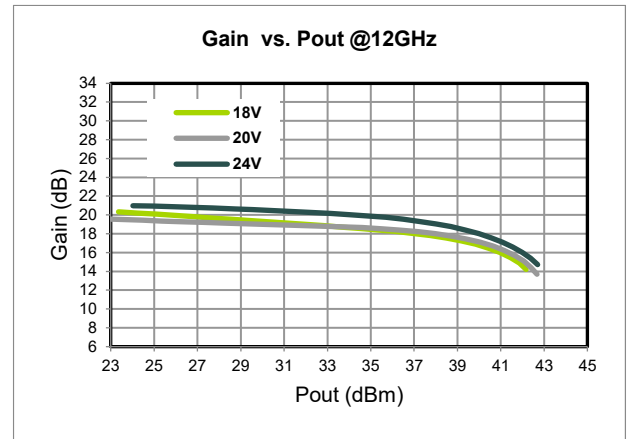
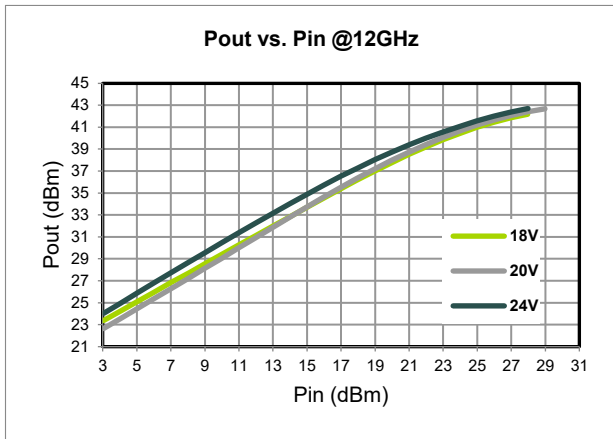
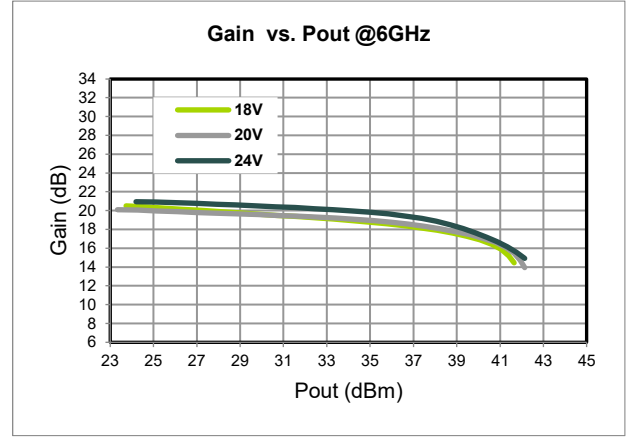
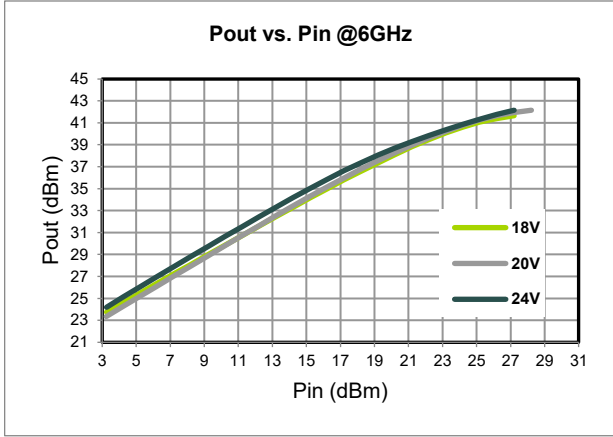


Typical Large Signal Data, CW | Test conditions unless otherwise stated $V_D=24V$, $I_{DQ}=280mA$, $T_A=25^\circ C$, CW



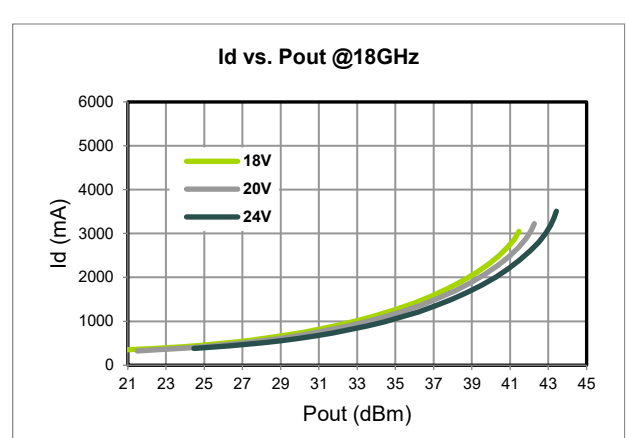
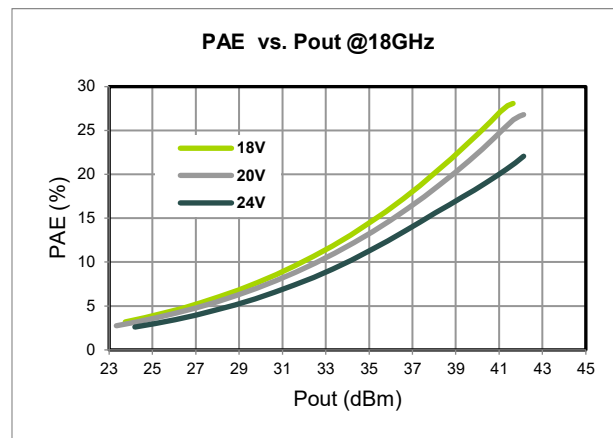
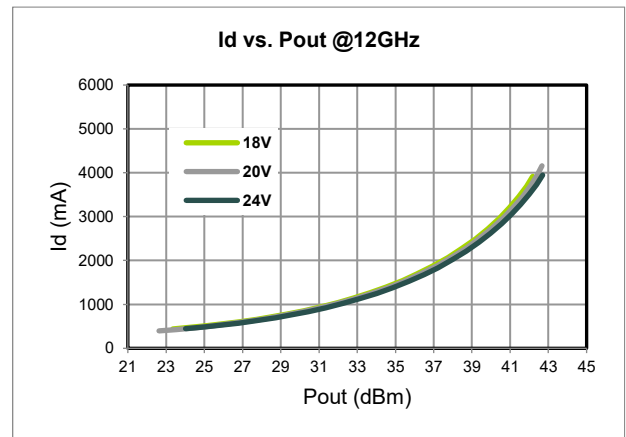
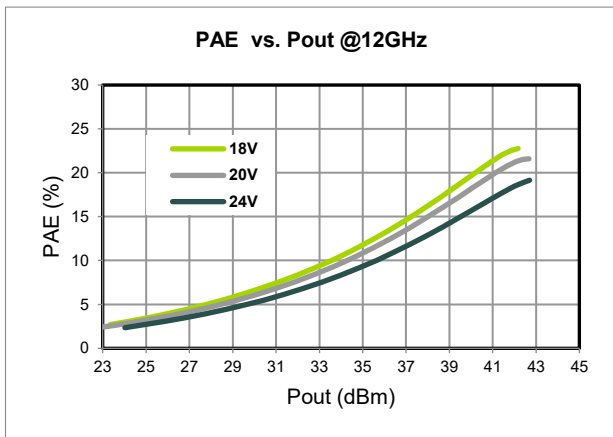
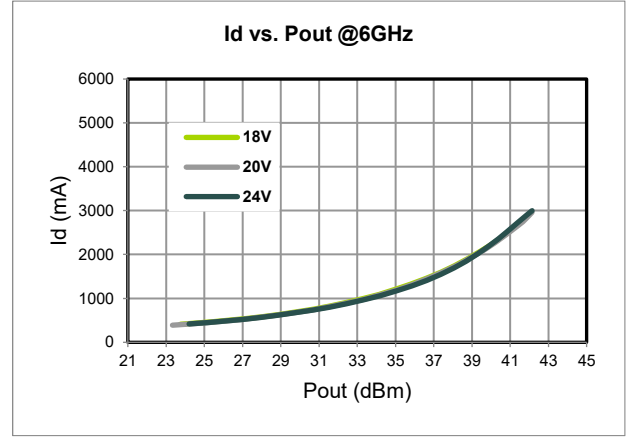
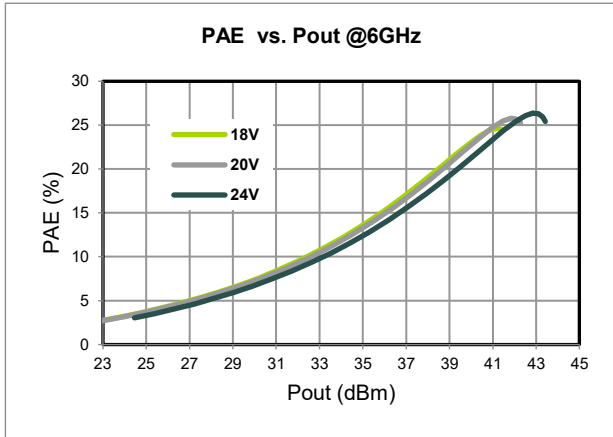


Typical Large Signal Data, CW | Test conditions unless otherwise stated $V_D=18V, 20V, 24V$, $I_{DQ}=280mA$, $T_A=25^\circ C$, CW



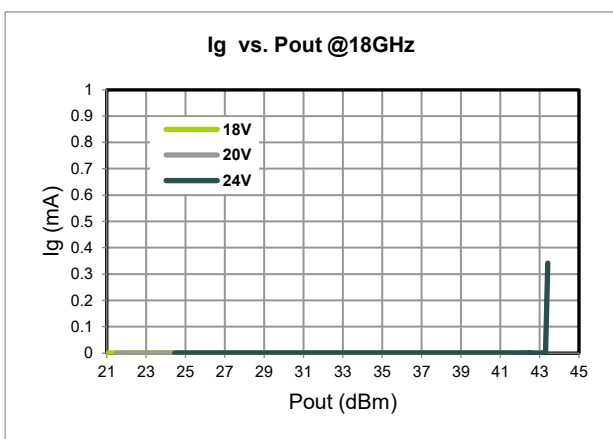
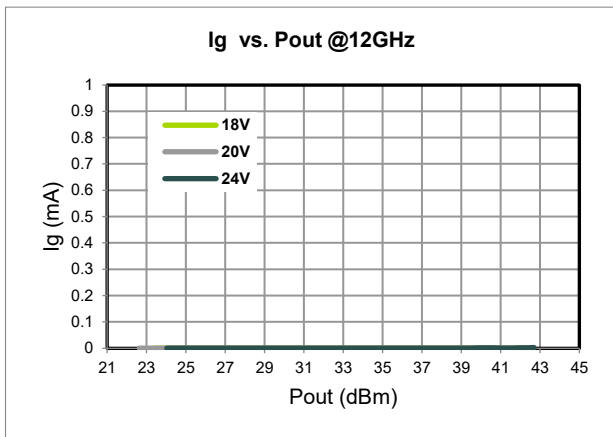
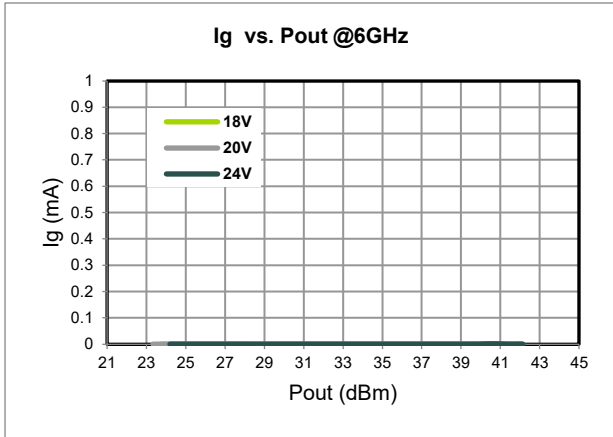


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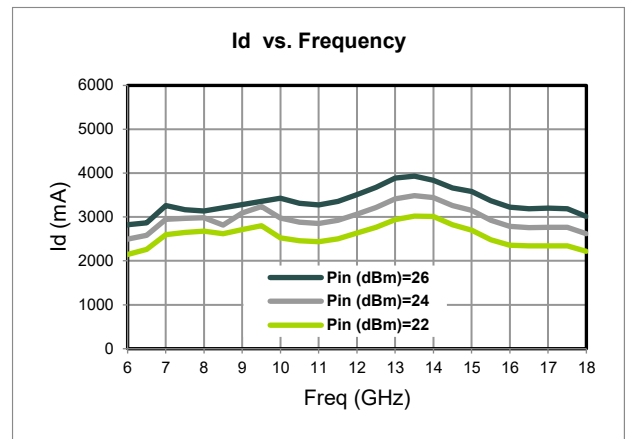
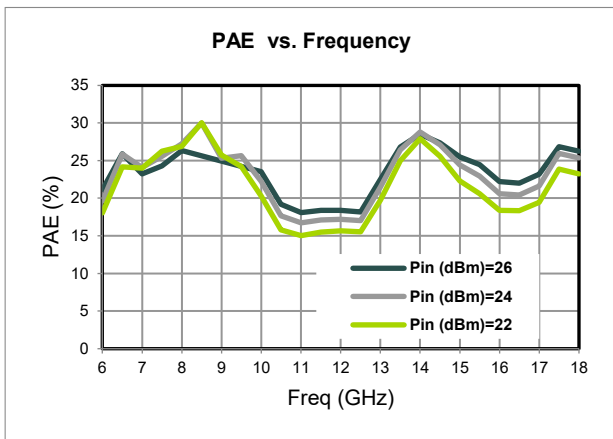
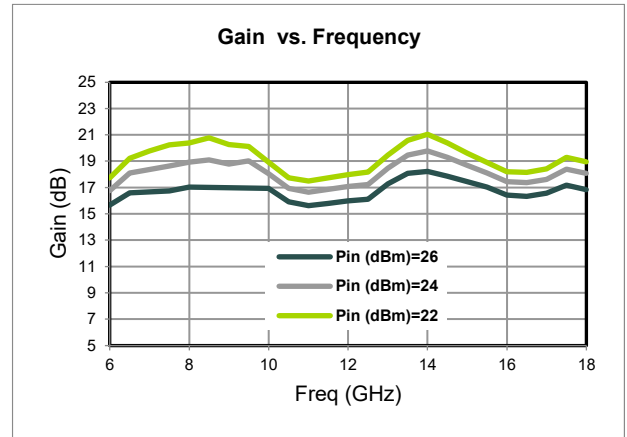
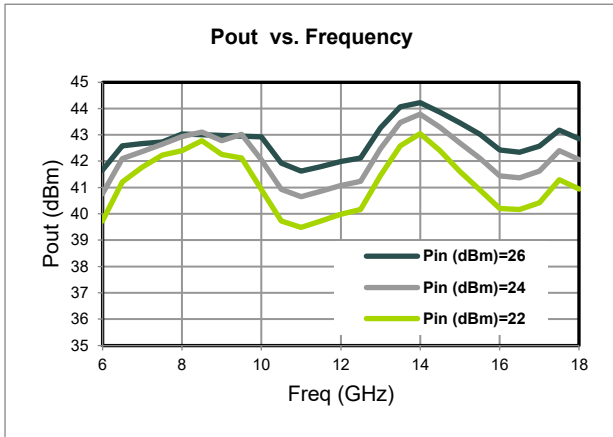


Typical Large Signal Data, CW | Test conditions unless otherwise stated $V_D=18V, 20V, 24V$, $I_{DQ}=280mA$, $T_A=25^\circ C$, CW



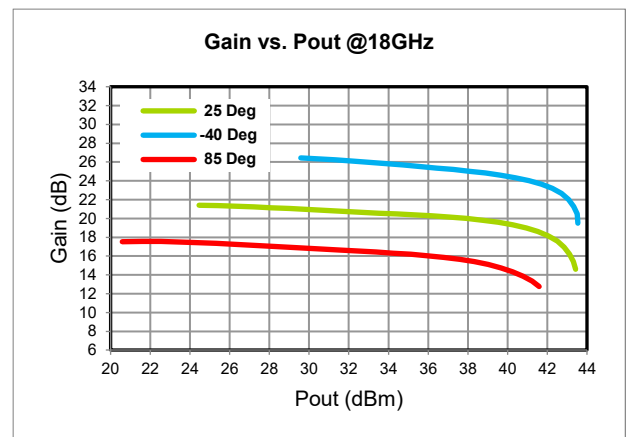
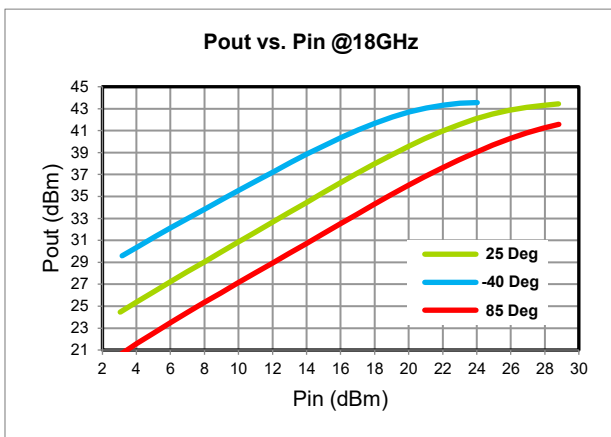
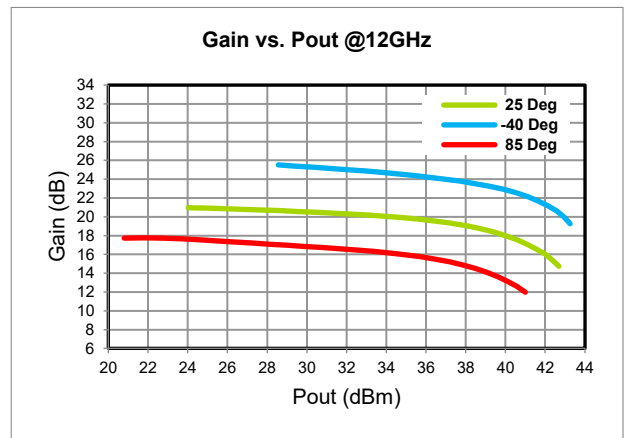
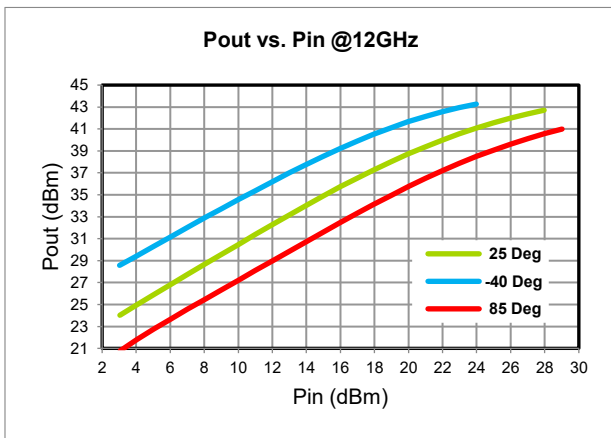
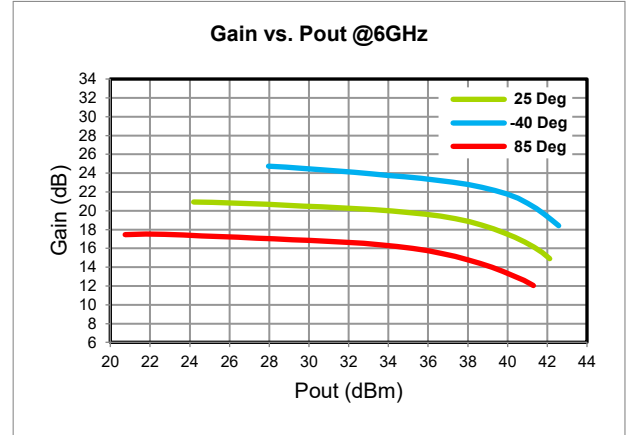
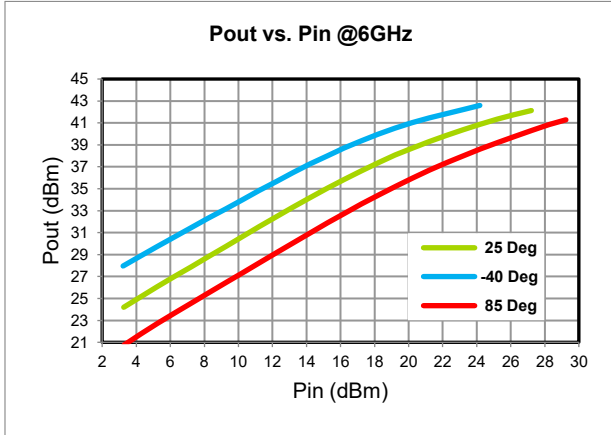


Typical Large Signal Data, CW | Test conditions unless otherwise stated $V_D=24V$, $I_{DQ}=280mA$, $T_A=25^\circ C$, CW



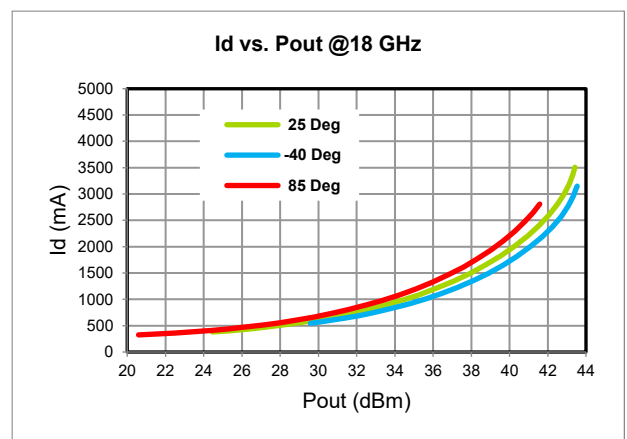
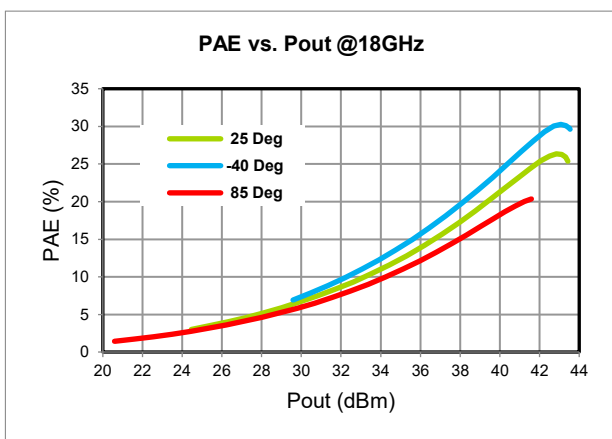
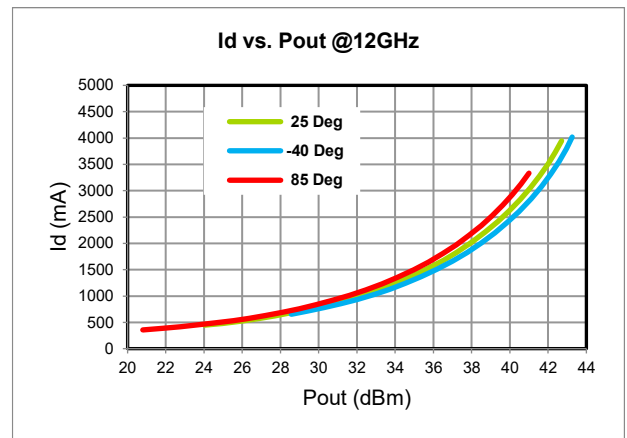
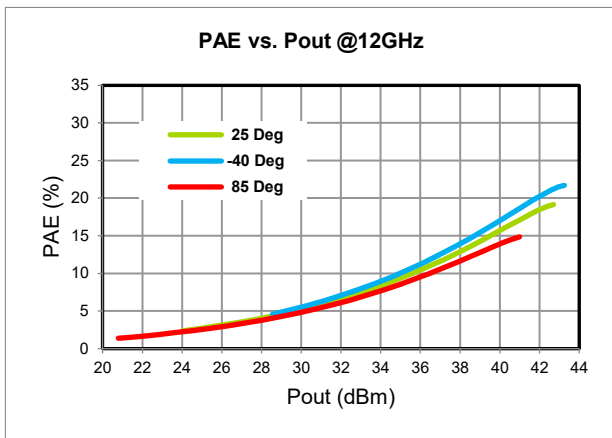
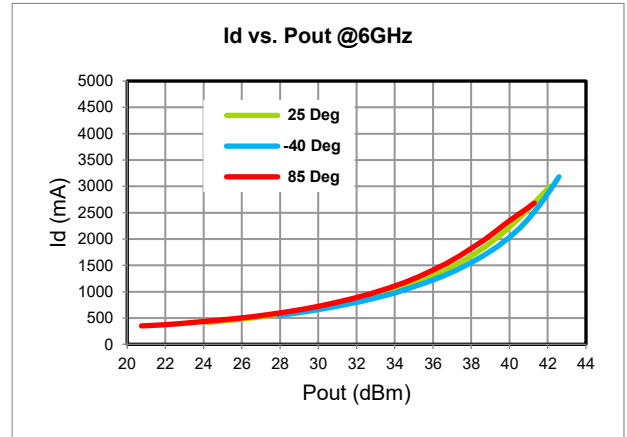
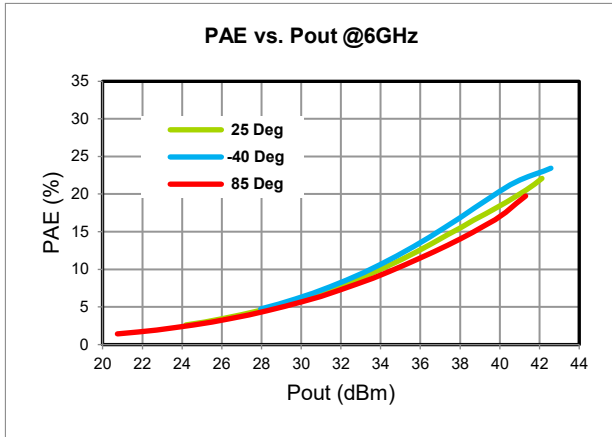


Typical Large Signal Data, CW | Test conditions unless otherwise stated $V_D = 24V$, $I_{DQ} = 280mA$, $T_A = 25^\circ C$, CW



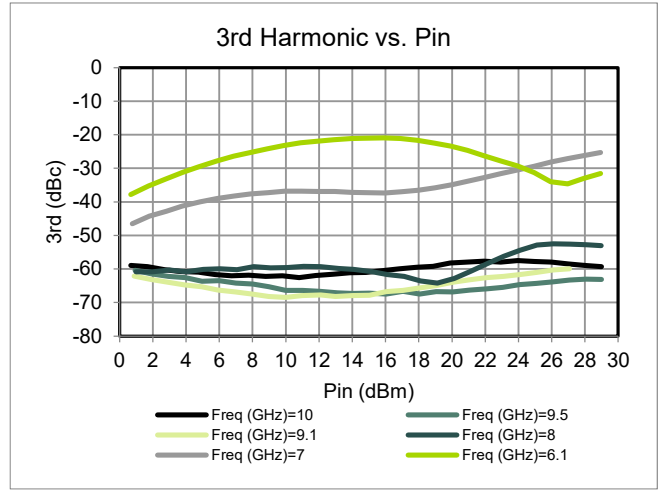
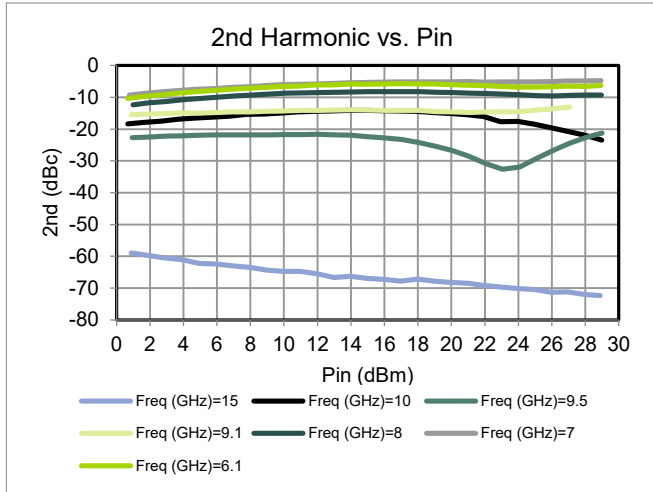


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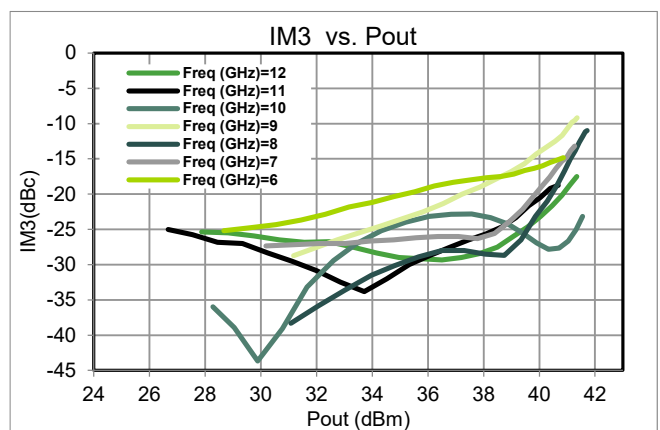
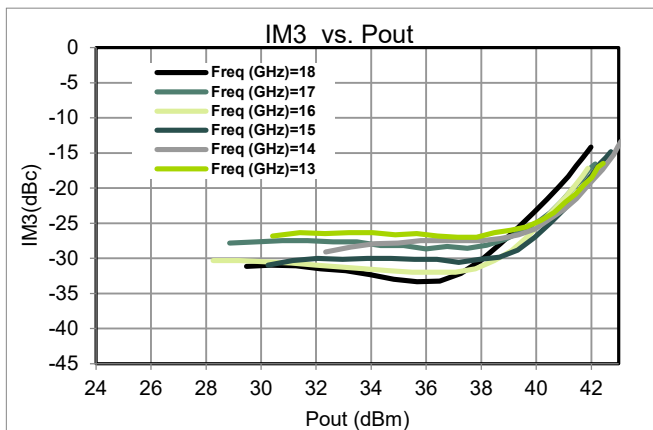




Typical Large Signal Data, 2nd, 3rd Harmonic

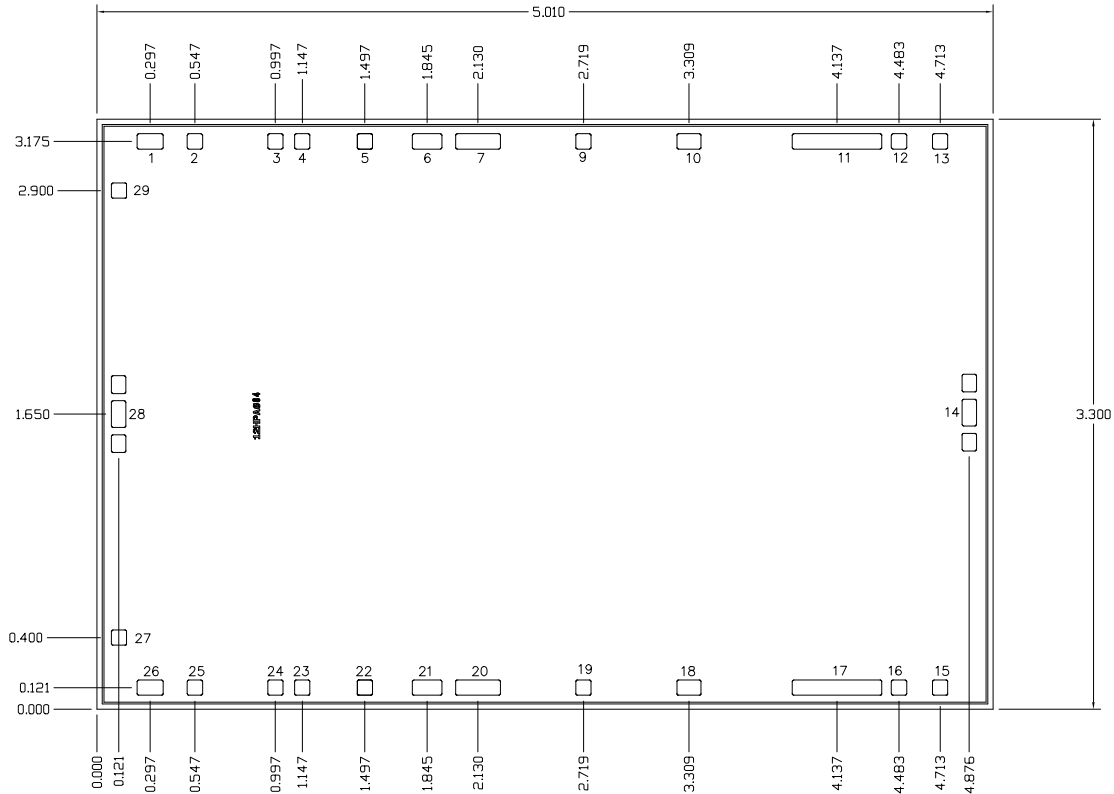
 Test conditions unless otherwise stated $V_D = 24V$, $I_{DQ} = 280mA$, $T_A = 25^\circ C$ 

Typical Linearity Data

 Test conditions unless otherwise stated $V_D = 24V$, $I_{DQ} = 280mA$, $T_A = 25^\circ C$, Tone Spacing 10MHz



Mechanical Drawing



Units: mm

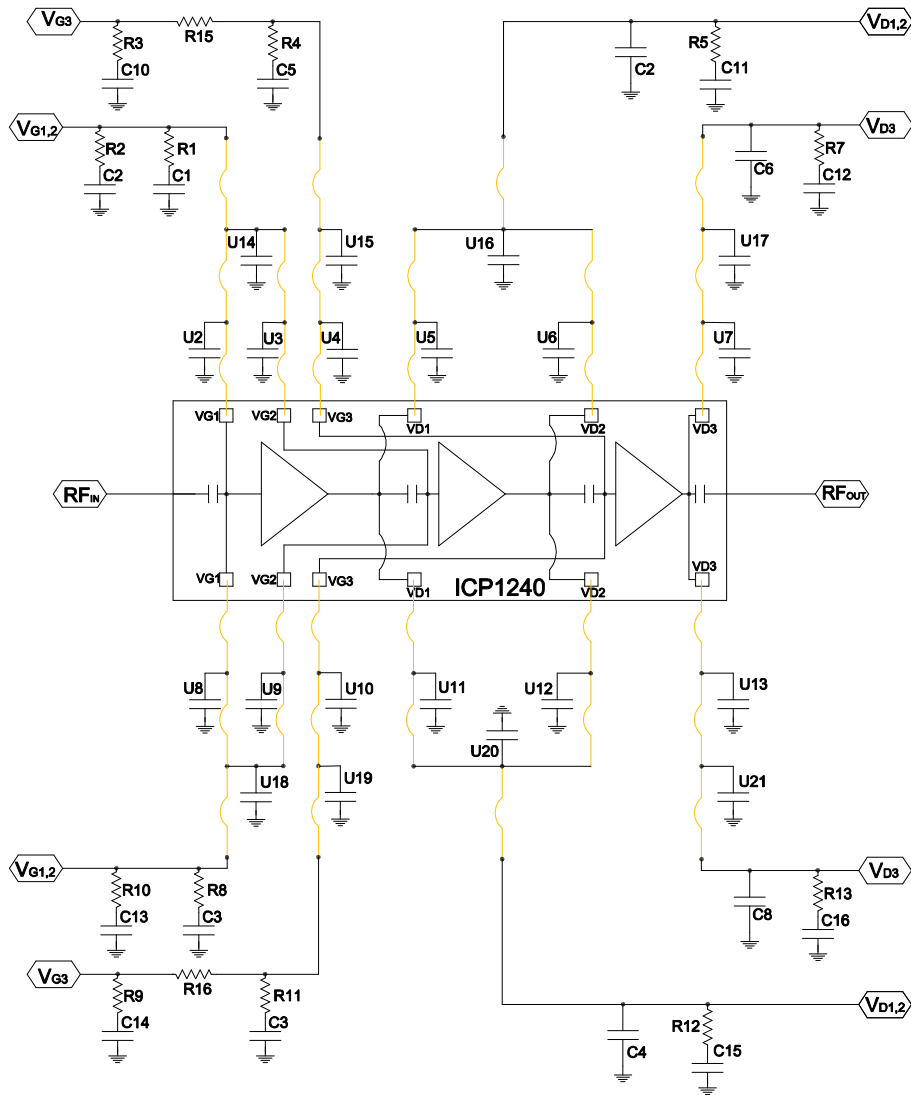
Thickness: 100um

Backside is RF and DC ground

Pad No	Pad Size	Function	Description
1,10,18,26	145x85	Ground	Ground
3,12,13,15,16,24	85x85	Ground	Ground
2,25	85x85	VG1	First stage north gate bias, decoupling and bypass caps required, must be biased from both sides
6,21	165x85	VD1	First stage north drain voltage, decoupling and bypass caps required, must be biased from both sides
4,23	85x85	VG2	Second stage gate bias, decoupling and bypass caps required, must be biased from both sides
7,20	250x85	VD2	Second stage drain voltage, decoupling and bypass caps required, must be biased from both sides
5,9,19,22	85x85	VG3	Third stage gate bias, decoupling and bypass caps required, must be biased from both sides
11,17	500x85	VD3	Third stage drain voltage, decoupling and bypass caps required, must be biased from both sides
14	80x150	RFOUT	50 ohm RF output, DC blocked, pad is DC grounded
28	80x150	RFIN	50 ohm RF input, DC blocked



Application Circuit

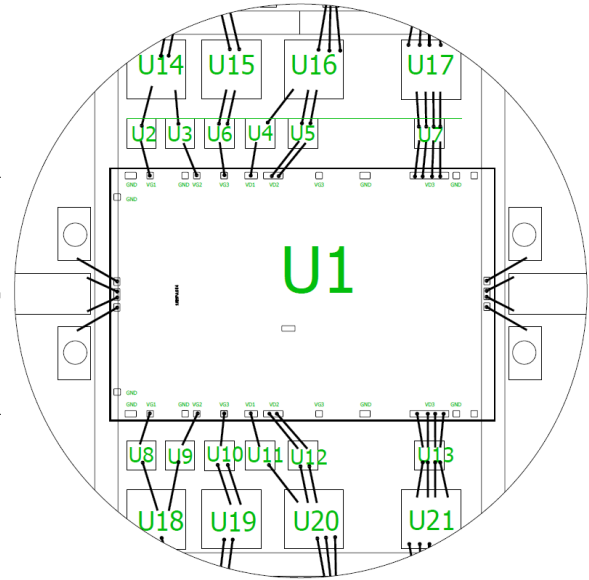
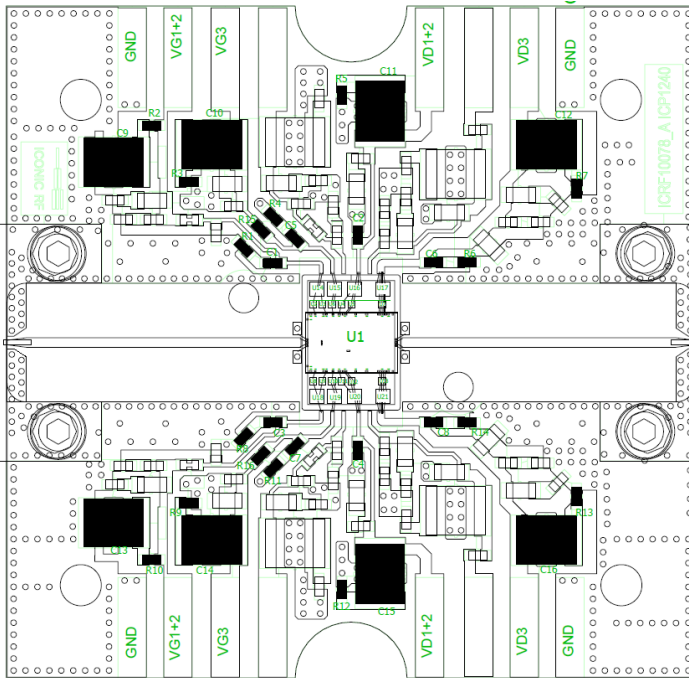


Bill of Materials

Assembly Reference	Value	Description
U1		6-18GHz MMIC
U2-U13	100pF	Johanson 100pF SLC Capacitor
U14-U21	10nF	10nF SLC Capacitor
C1,C3,C5,C7	100nF	100nF Capacitor,10%,50V,0402
C2,C4,C6,C8	10nF	10nF Capacitor,10%,50V,0402
C9-C16	10uF	10uF Capacitor,10%,50V,1206
R1-R5,R7-R13	5.1Ohms	5.1 Ohms Resistor,0402
R6,R14	0 Ohm	0 Ohm Resistor,0402
R15,R16	82Ohm	82Ohm Resistor



Assembly Drawing



PCB Fabrication

PCB Construction	Material	Dimensions	Key Features	Dimensions
METAL1_TOP	Cu + ENIG	1oz Cu plated Electroless Nickel 3-5µm	VIA Drill	0.3mm
DIELECTRIC	RO4350C	10mils (254µm)	VIA Plating Thickness	50-70um
METAL2_BOTTOM	Cu + ENIG	1oz Cu plated Electroless Nickel 3-5µm	50 Ohm Line Width	525um

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 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.

Reflow Process

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

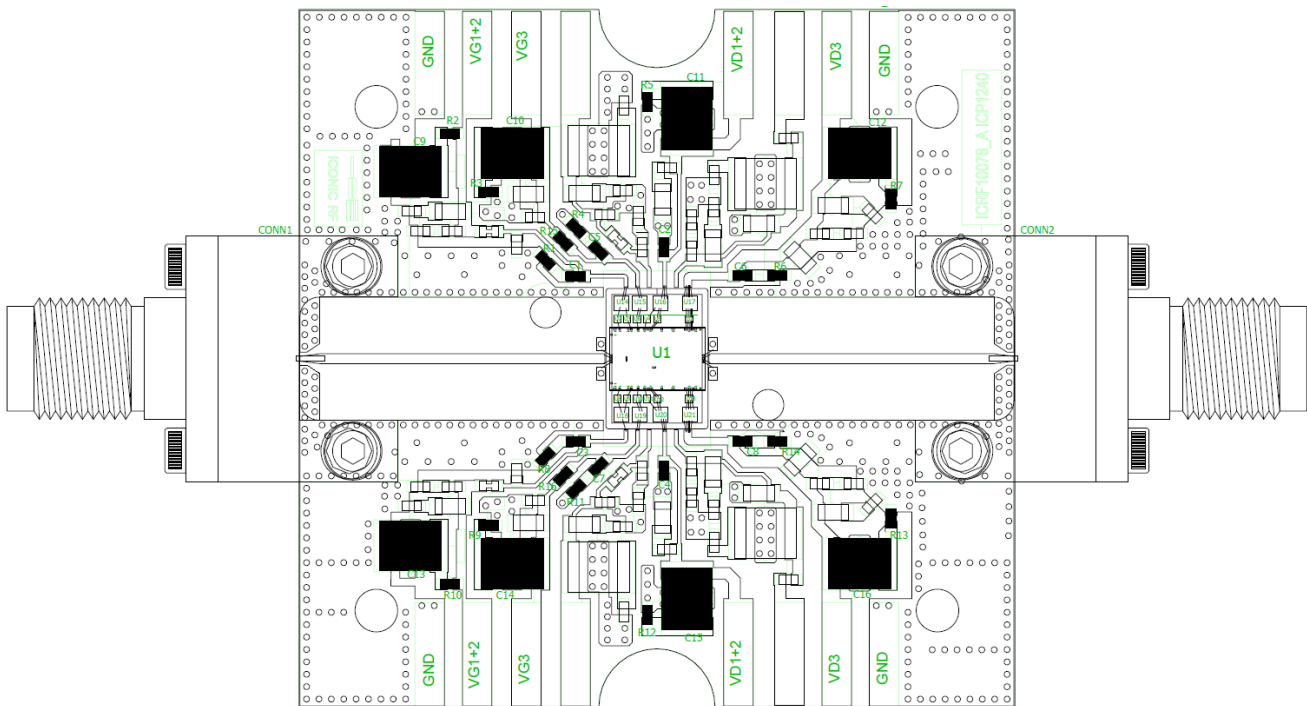


Assembly Guidance continued.

For optimum RF and thermal performance 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 170 μ m 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 280mA
4. Limit I_D to 4.5A
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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