ICONIC RF

a MICROCHIP company

12-18GHz 20W GaN PA MMIC

ICP1543

Description

ICONICRF's ICP1543 is a three stage MMIC power amplifier in bare die form, fabricated using GaN on SiC technology. ICP1543 operates from 12-18GHz with 43dBm output power, >30% PAE and 22dB small signal gain. ICP1543 is well suited to a variety of Test and Measurement and Aerospace & Defense applications.

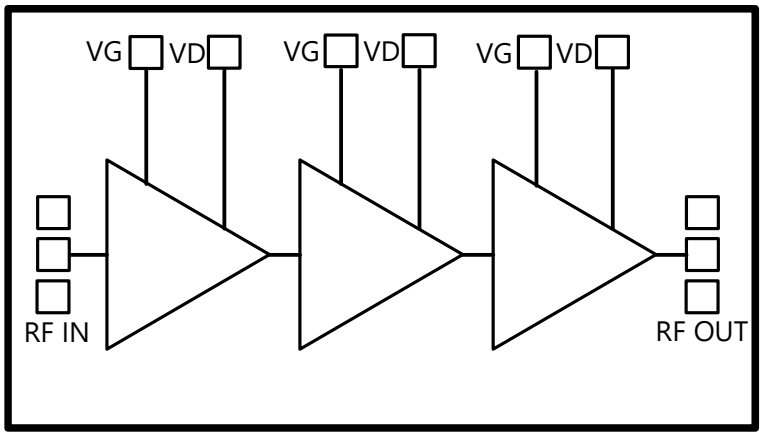
Features

- Frequency Range: 12-18GHz
- Pout: 43 dBm @ 24dBm Pin
- PAE: >30 %
- Small Signal Gain: 22dB
- Bias: VD=24V IDQ=150mA
- Technology: GaN on SiC
- Lead-free and RoHS compliant
- Die Size = 3.75 mm x 3.45 mm

Applications

- Test and Measurement
- Aerospace & Defense

Functional Block Diagram



Electrical Specifications | Test conditions unless otherwise stated | V_D=24V, I_{DQ}=150mA T_A=25 °C, CW

Parameter	Conditions (1)	Min	Typ	Max	Units
Frequency		12		18	GHz
Output Power @ P_{sat}	Pin=25dBm		43		dBm
PAE @ P_{sat}	Pin=25dBm		30		%
Small Signal Gain			22		dB
Input Return Loss			10		dB
Output Return Loss			7		dB

Recommended Operating Conditions

Parameter	Value
Drain Voltage (V_D)	20V-24V
Drain Quiescent Current (I_{DQ})	150-300mA
Gate Voltage Range (V_G)	-2 to –1.5V
Operating Temperature (T_A)	-40 to +85C

Absolute Maximum Ratings

Parameter	Absolute Maximum
Drain Voltage (V_{DG})	30V
Gate Voltage Range (V_G)	-5V to 0V
Drain Current (I_D) T_A=25ºC	8A
Gate Current (I_G)	6.0mA
Power Dissipation (CW) T_A=25ºC Power Dissipation (CW) T_A=85ºC	180W 125W
CW Input Power	+28dBm
Channel Temperature	275°C
Eutectic Die Attach Temperature (30s)	320°C
Storage Temperature	-65°C to +150°C

Exceeding any one or combination of the absolute maximum limits may cause permanent damage to this device.
ICONICRF does not recommend sustained operation near these survivability limits.

Thermal and Reliability

Parameter	Value
Thermal Resistance	1.1ºC/W

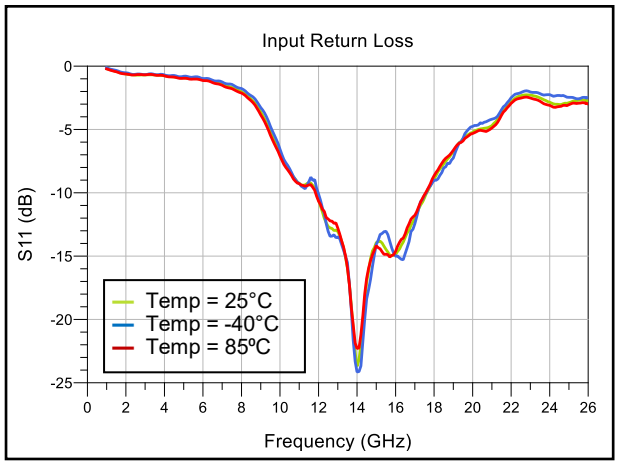
Notes

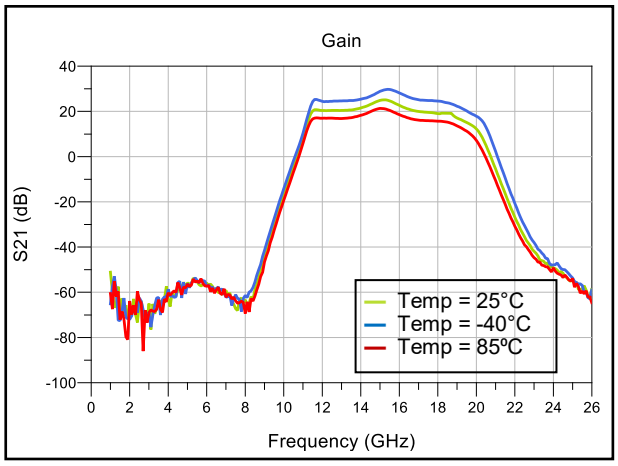
1. Assumes silver sintered epoxy attach (15um thick) mounted on CuMo carrier.
2. Base temperature is assumed at the top of the CuMo carrier
3. Thermal resistance calculated using IR measurement of the channel temperature.

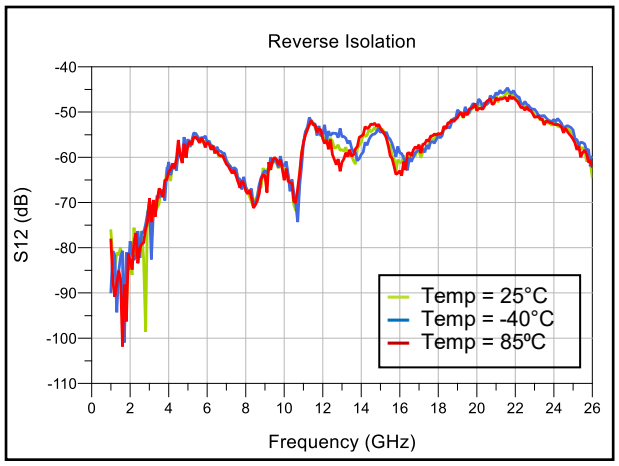
Ordering Information

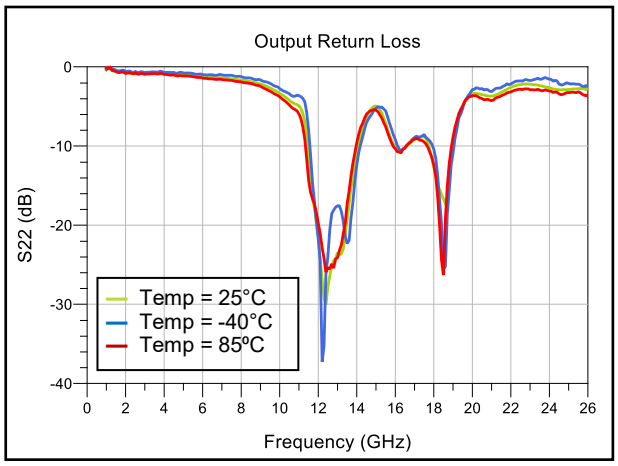
Part No.	Description
ICP1543-1-110I	Bare die in Gel-Pack trays
EV83T37A	ICP1543-1-501U EVB SMA connectors

Typical Small Signal Data | Test conditions unless otherwise stated V_D=20V, I_{DQ}=150mA

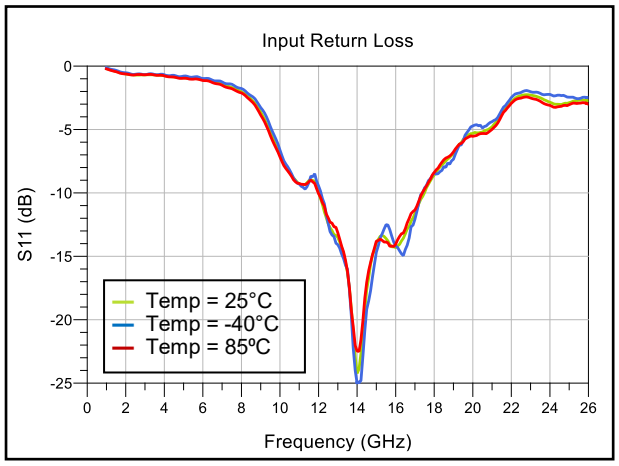


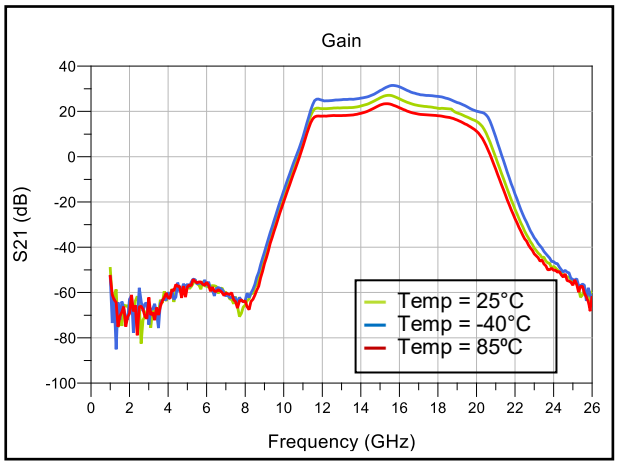


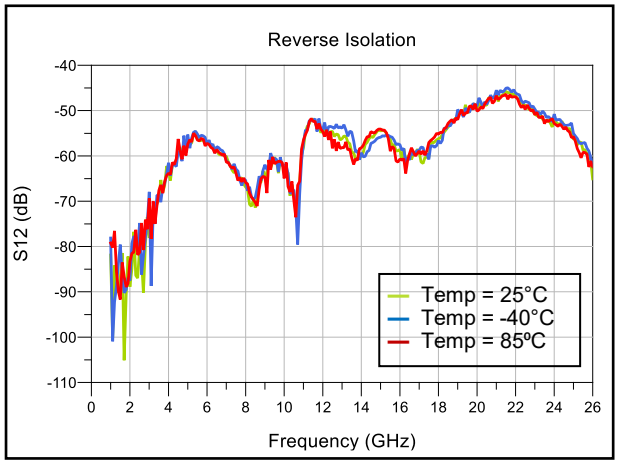


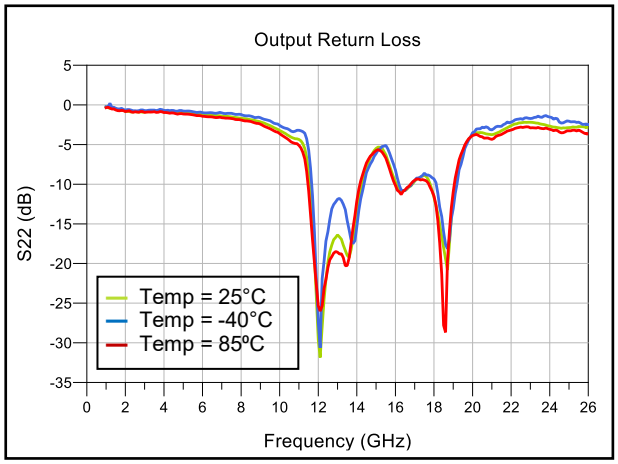


Typical Small Signal Data | Test conditions unless otherwise stated V_D=24V, I_{DQ}=150mA









Typical Large Signal Data |

Test conditions unless otherwise stated
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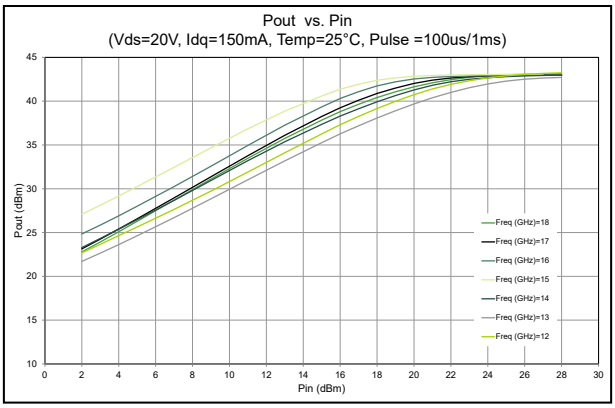
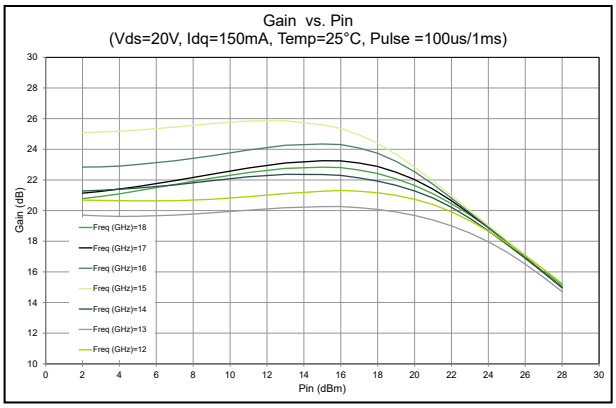
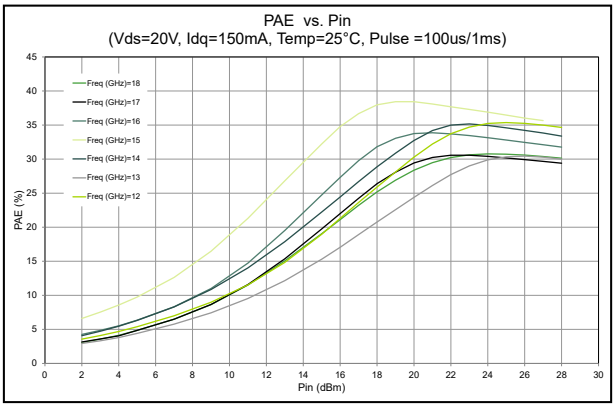
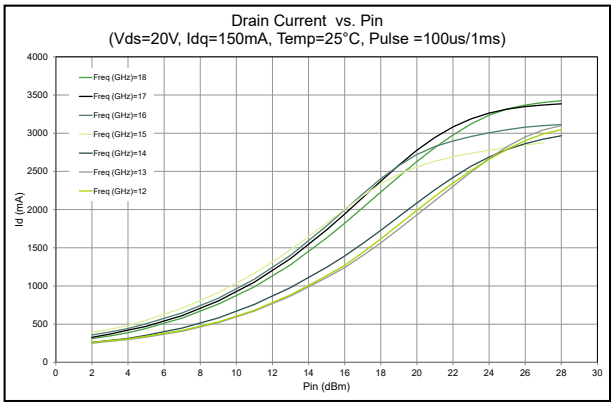
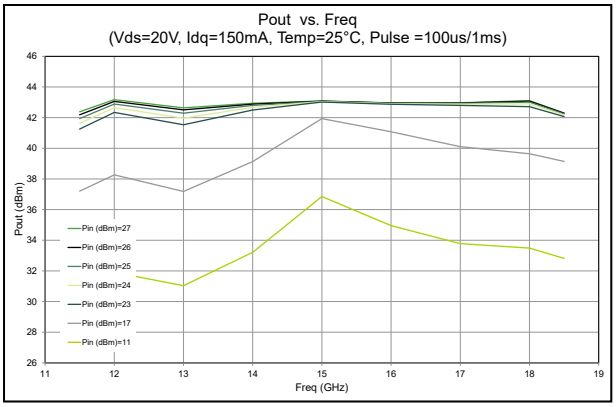
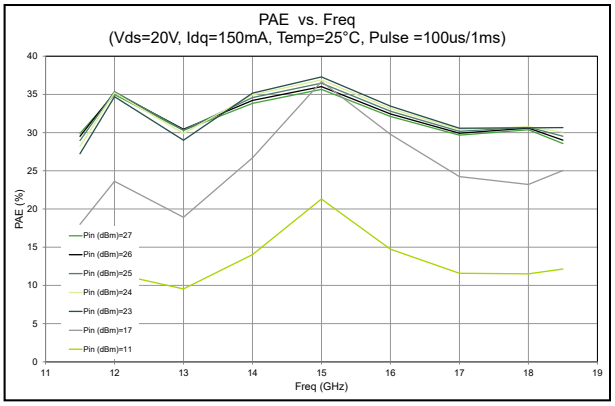






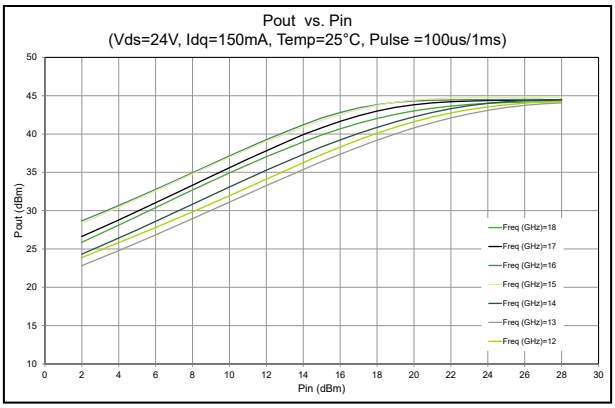


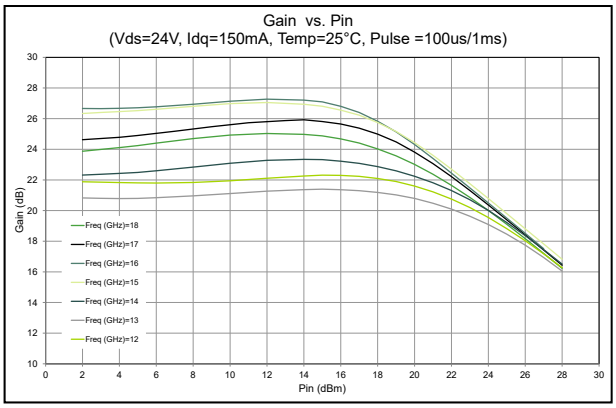


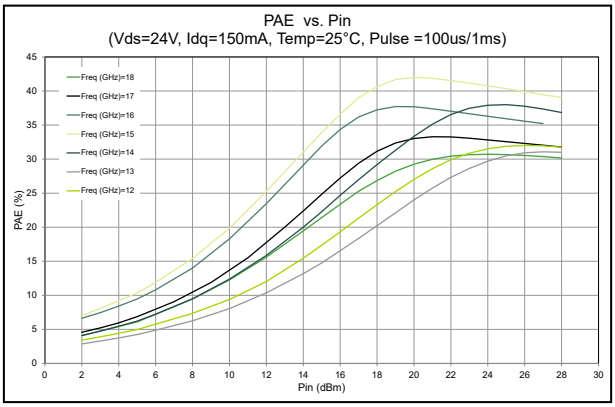


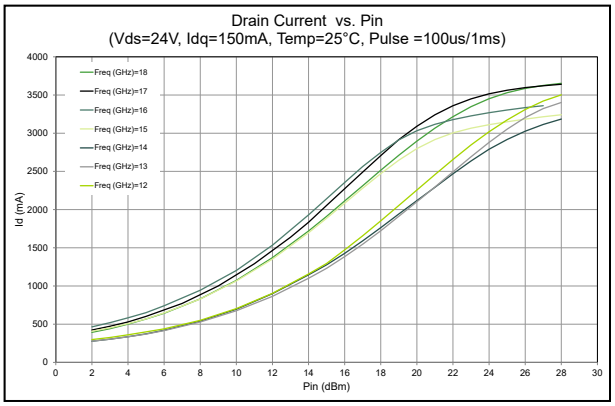
Typical Large Signal Data |

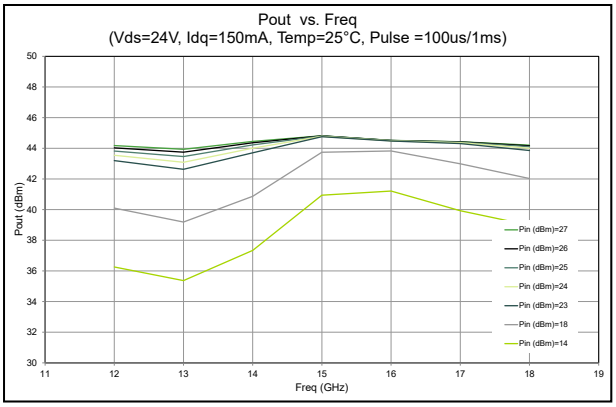
Test conditions unless otherwise stated
V_D=24V, I_{DQ}=150mA ,TA=25 °C, Pulse width=100us, Pulse period =1ms

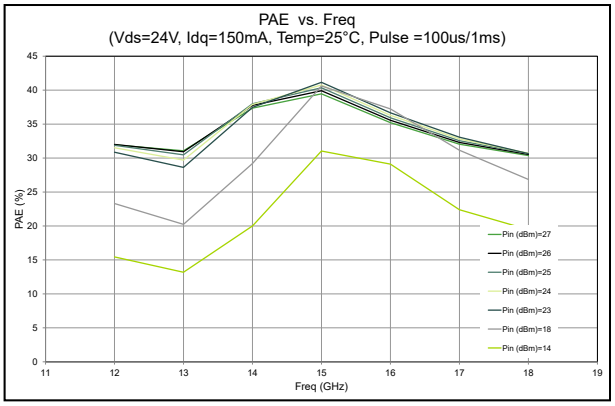




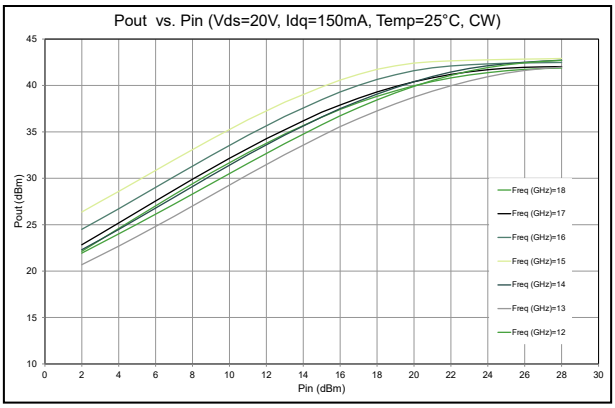


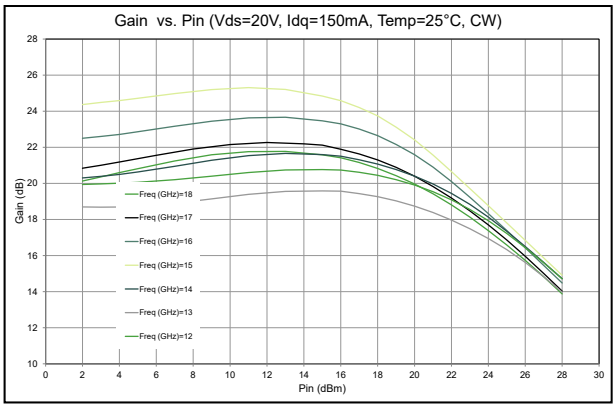


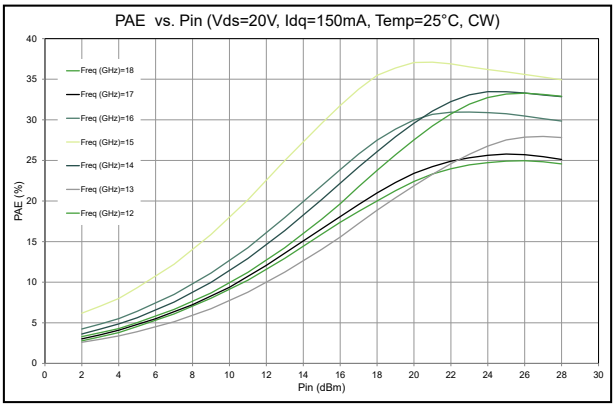


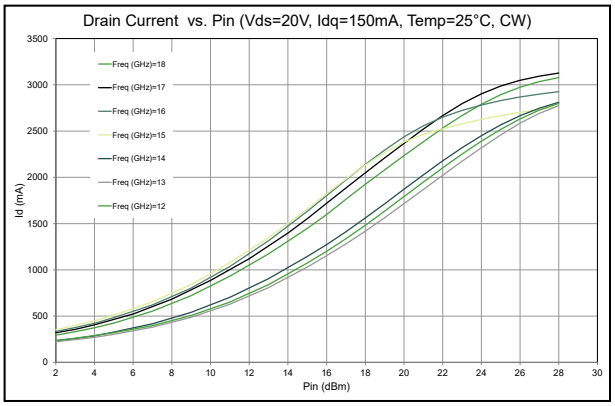


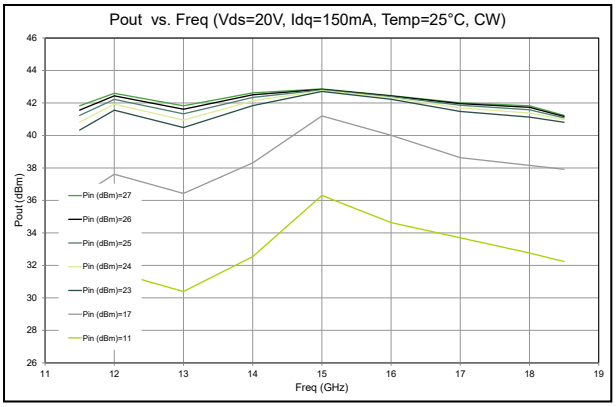
Typical Large Signal Data | Test conditions unless otherwise stated V_D=20V, I_{DQ}=150mA ,TA=25 °C, CW

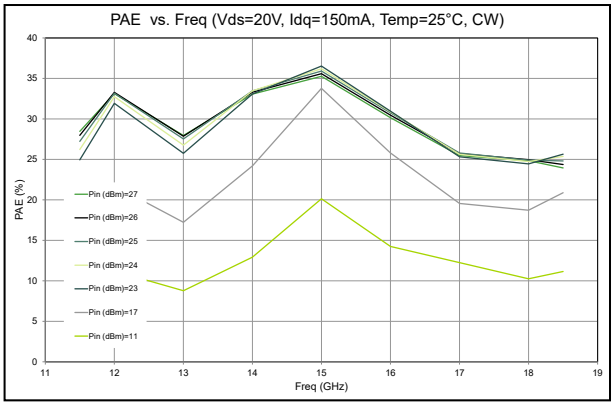




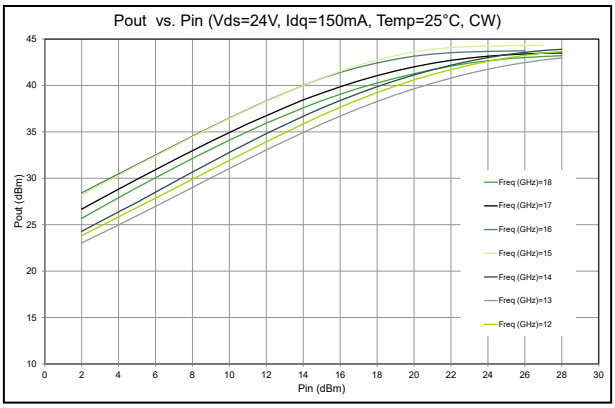


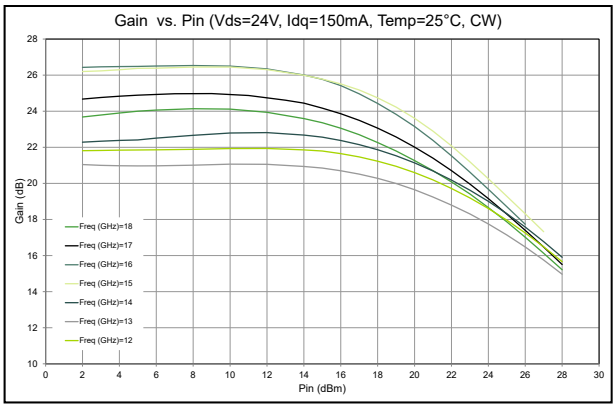


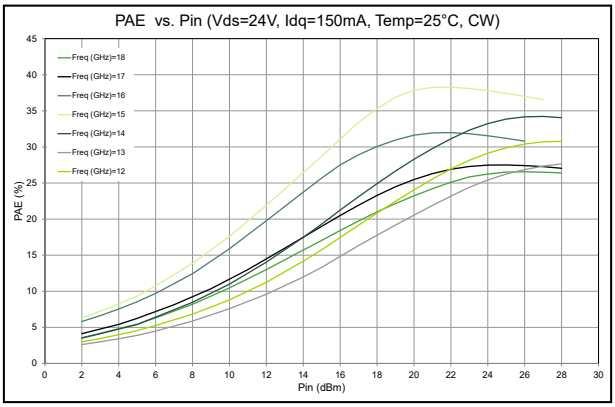


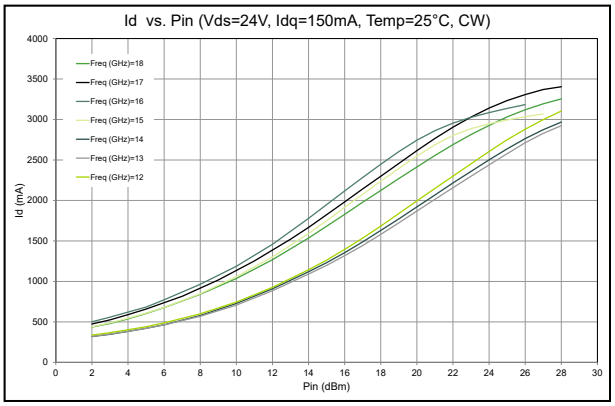


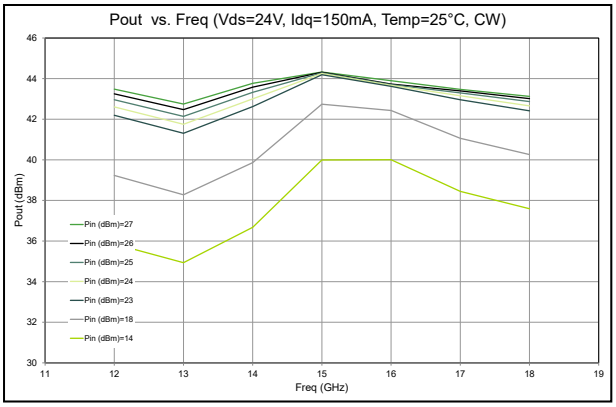
Typical Large Signal Data | Test conditions unless otherwise stated V_D=24V, I_{DQ}=150mA ,TA=25 °C, CW

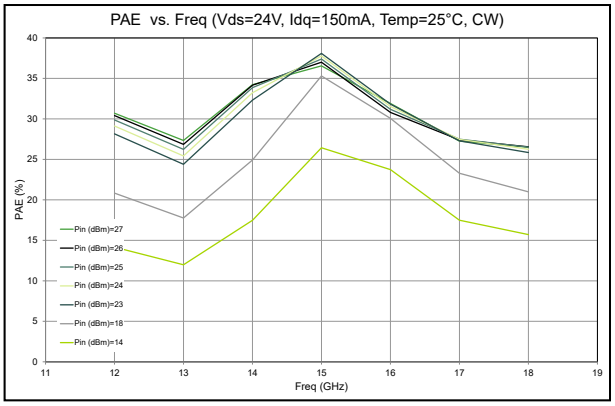












Typical Large Signal Data |

Test conditions unless otherwise stated
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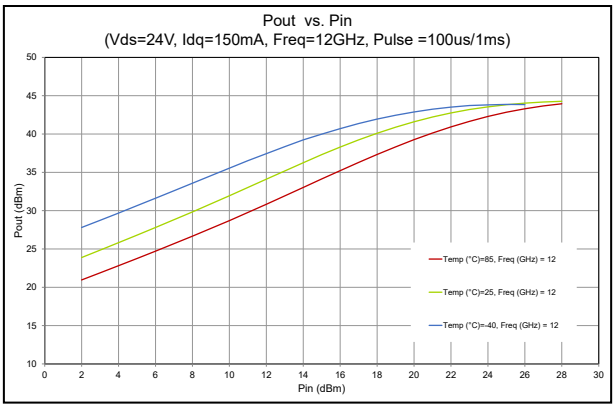

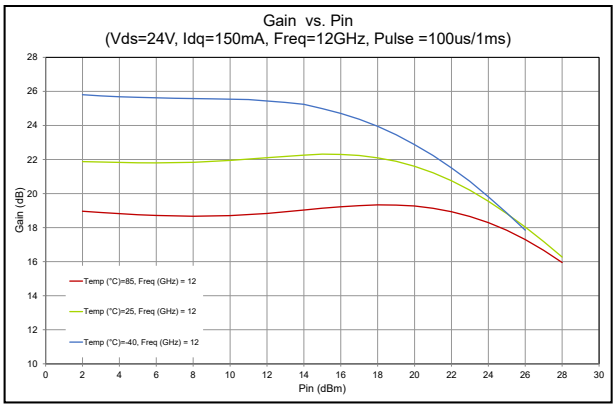

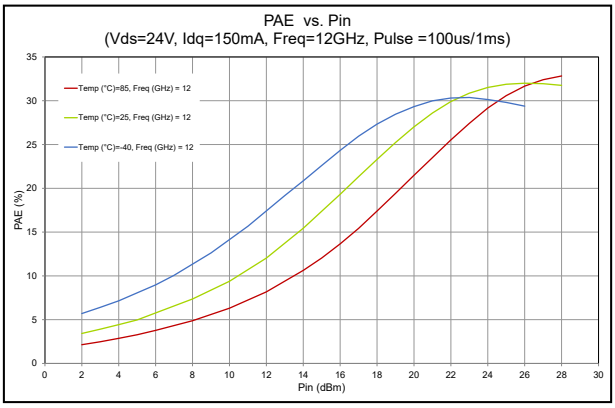

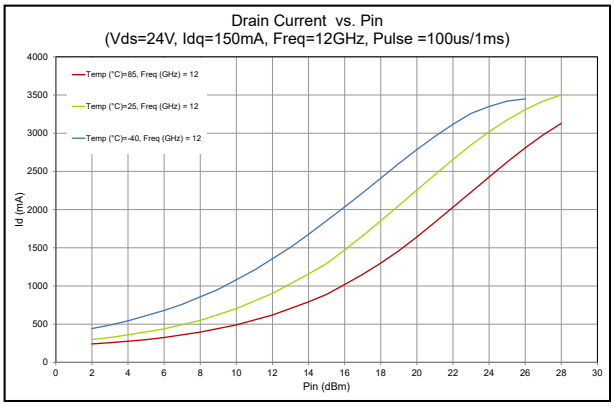

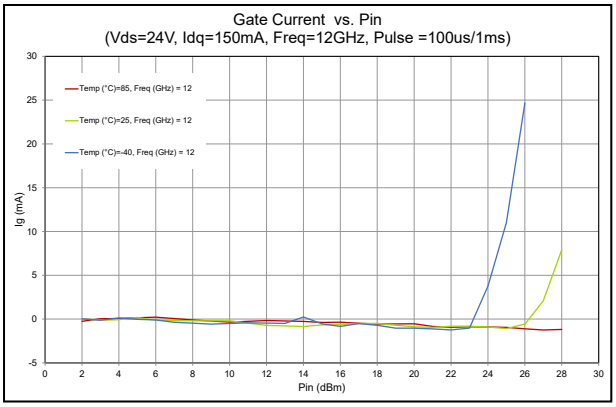

Typical Large Signal Data | Test conditions unless otherwise stated
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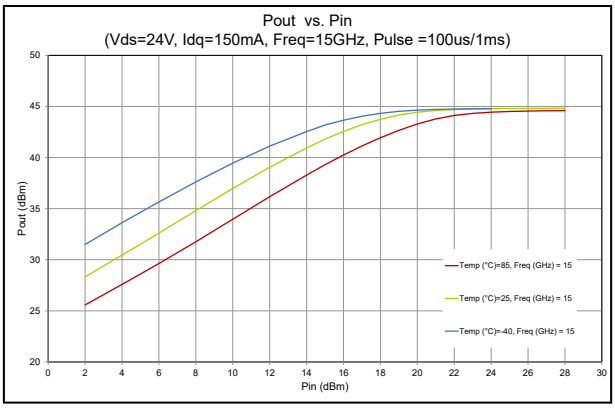

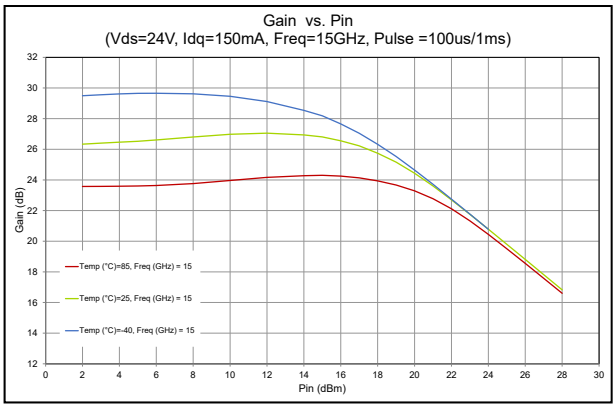

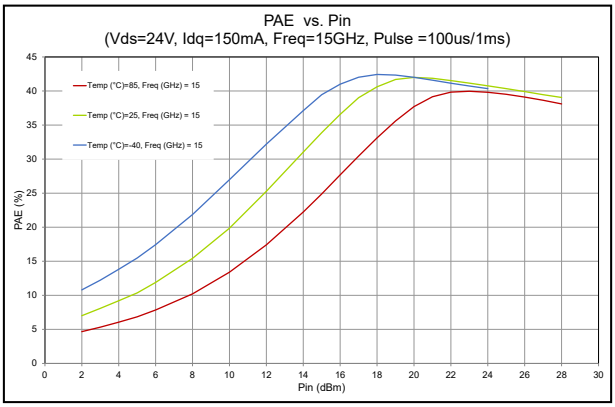

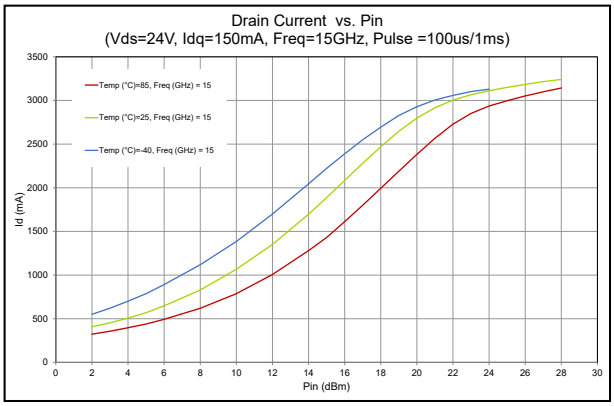

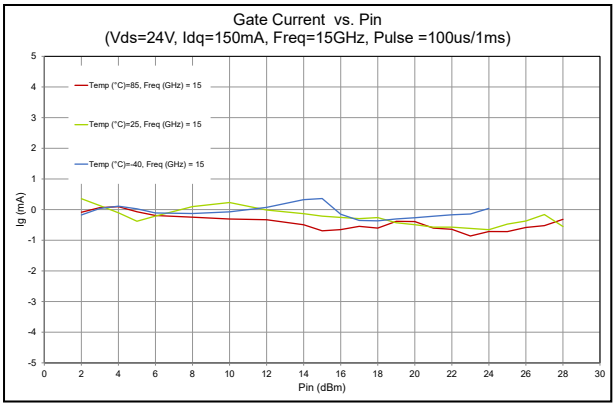

Typical Large Signal Data | Test conditions unless otherwise stated
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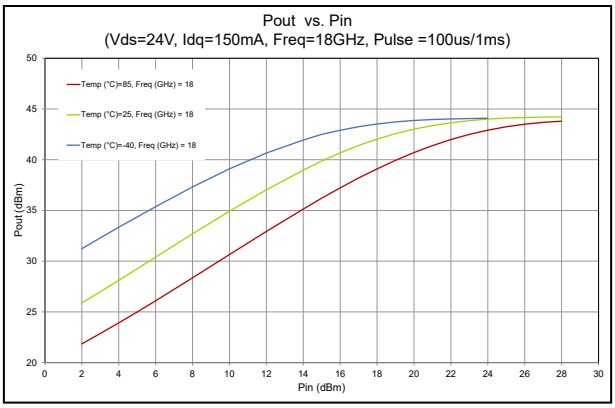
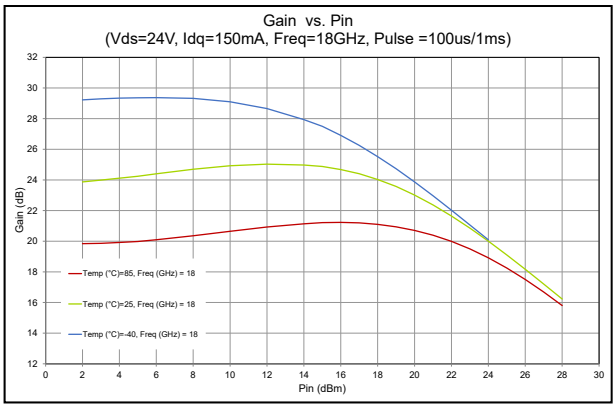
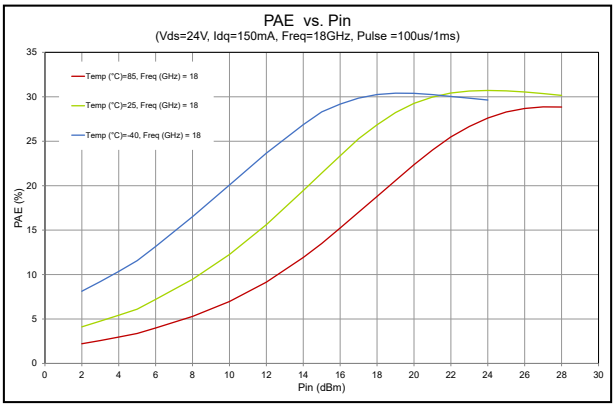
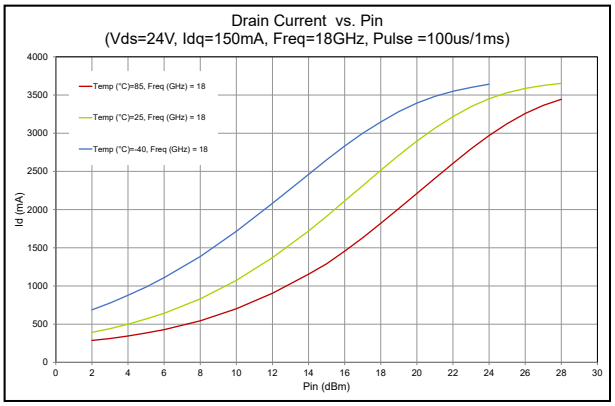
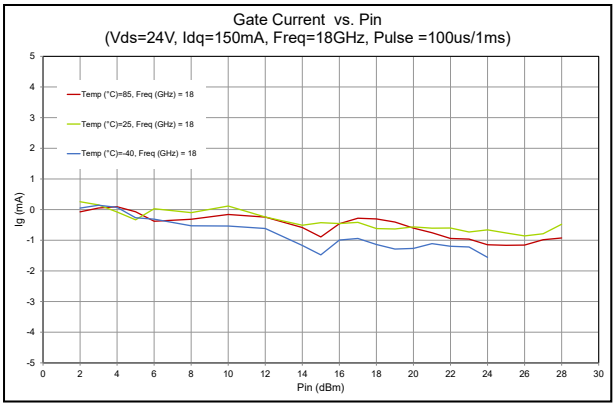


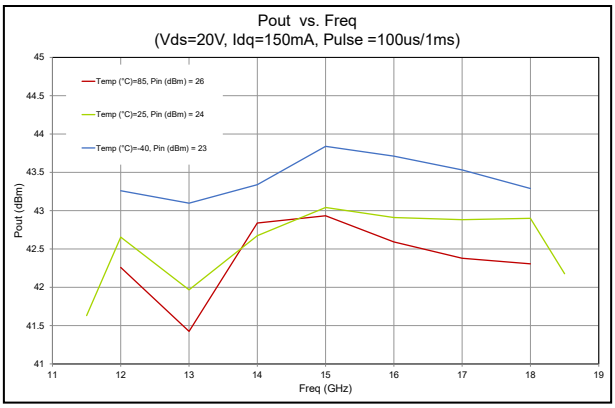


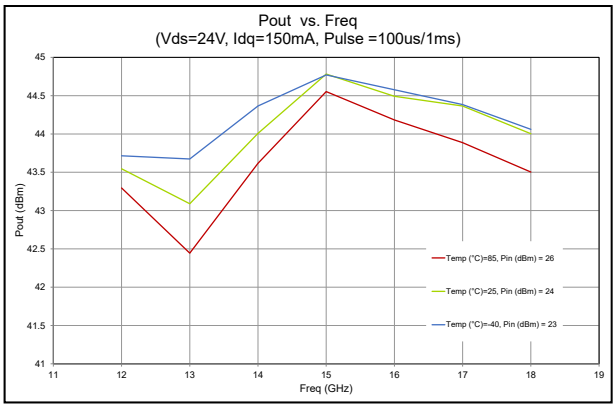


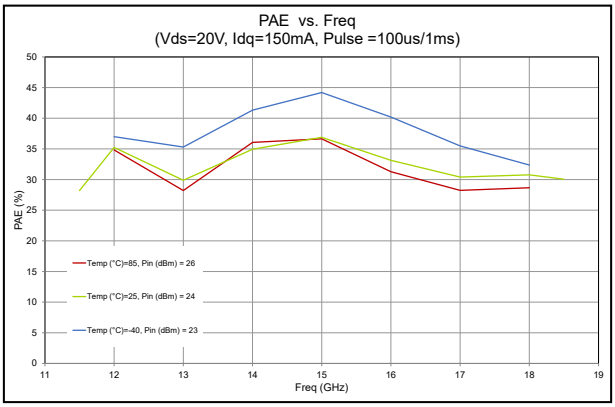


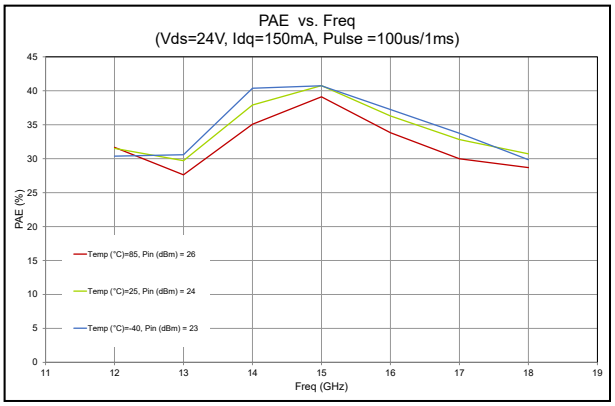


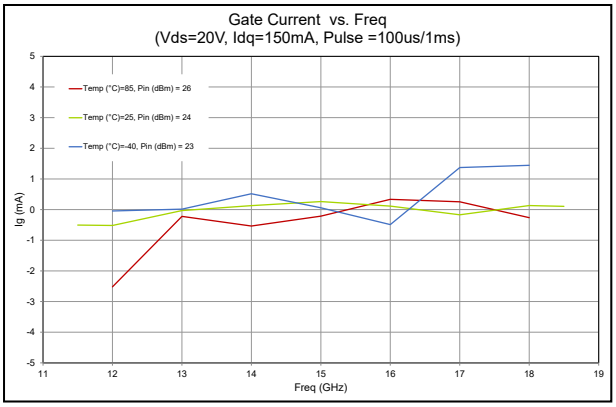
Typical Large Signal Data | Test conditions unless otherwise stated I_{DQ}=150mA , Pulse width=100us, Pulse period =1ms

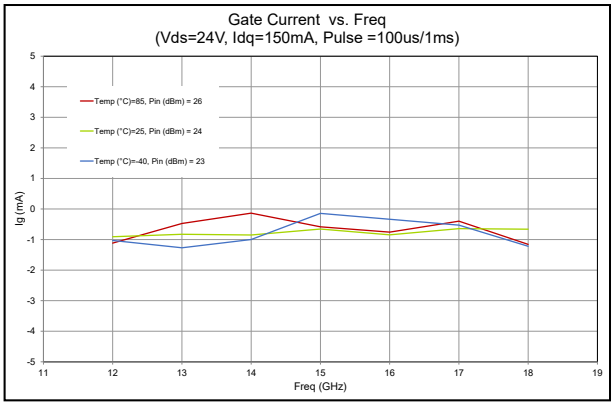




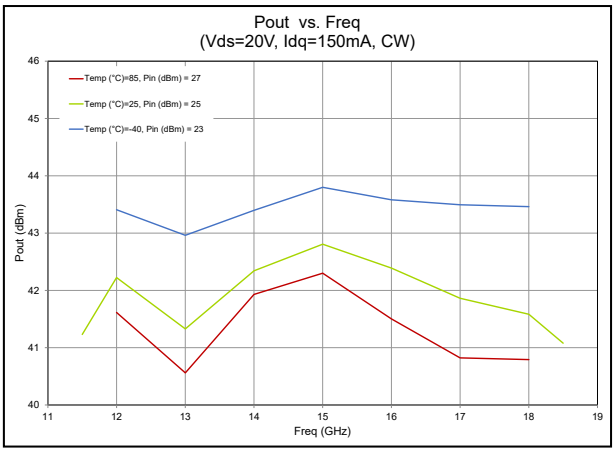


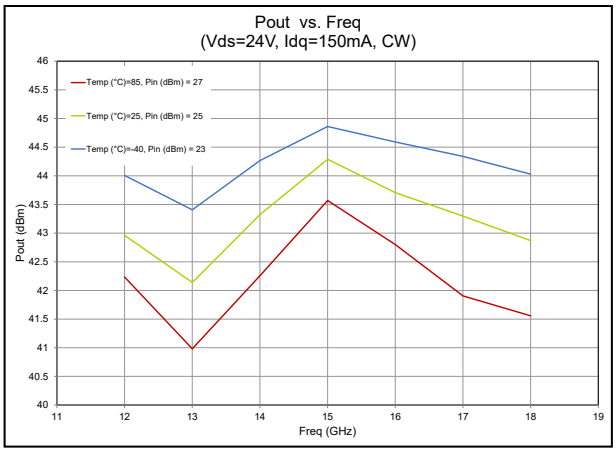


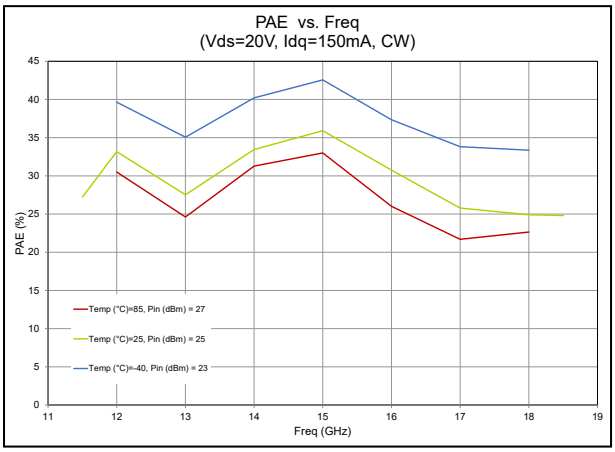


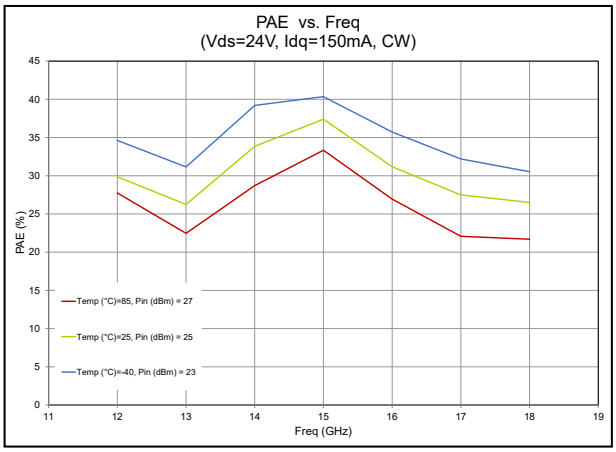


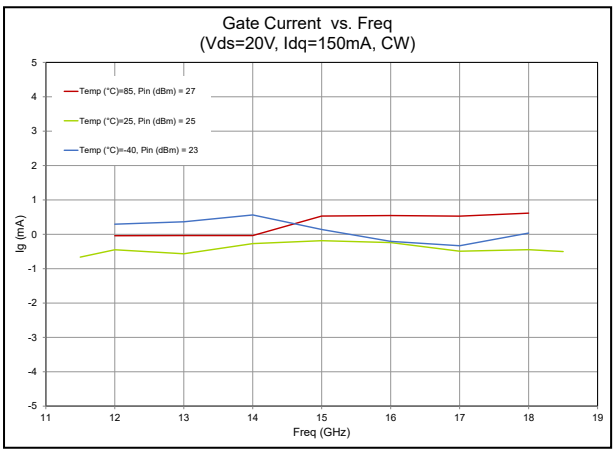
Typical Large Signal Data | Test conditions unless otherwise stated I_{DQ}=150mA , CW

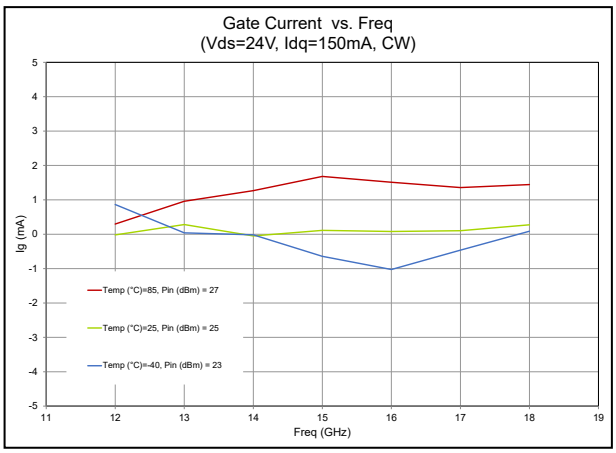




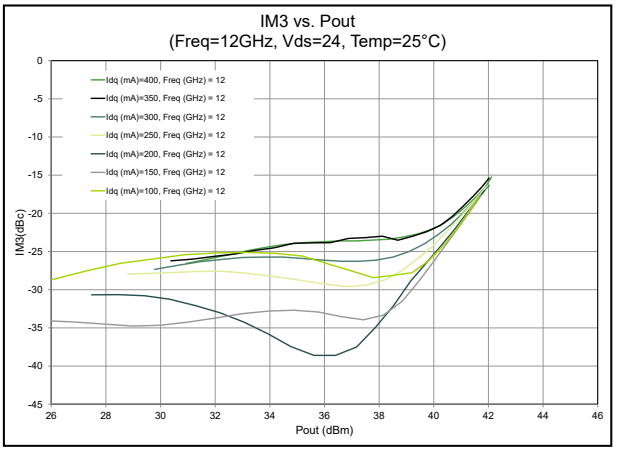


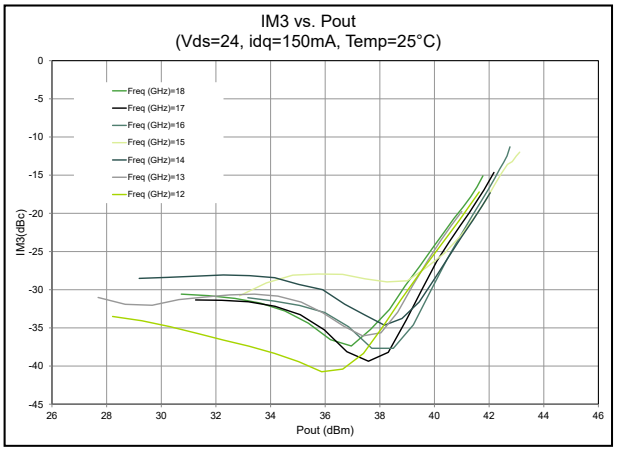


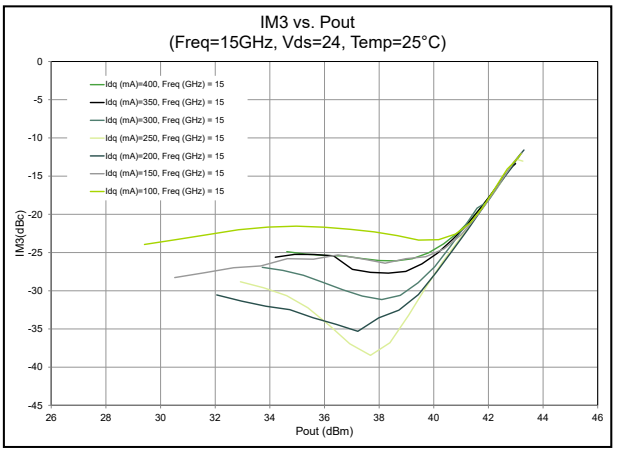


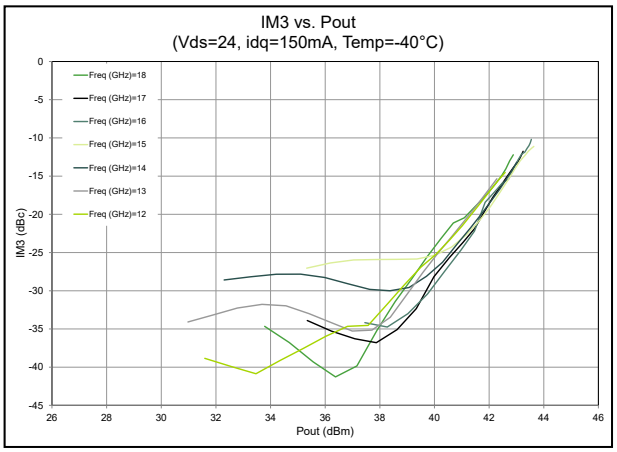


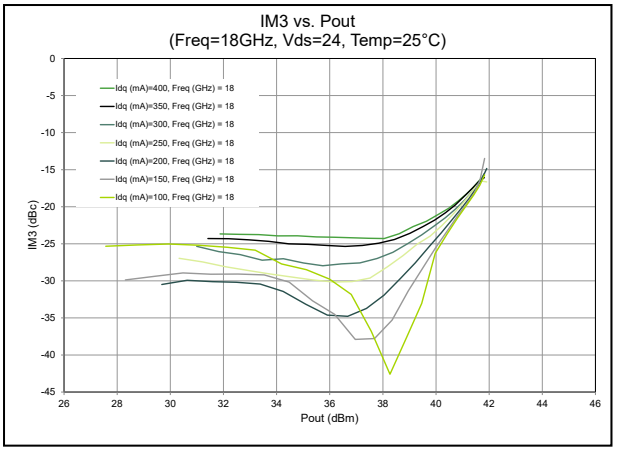
Typical Two Tone Data | Test conditions unless otherwise stated V_D=24V, I_{DQ}=150mA, Tone Spacing = 1MHz

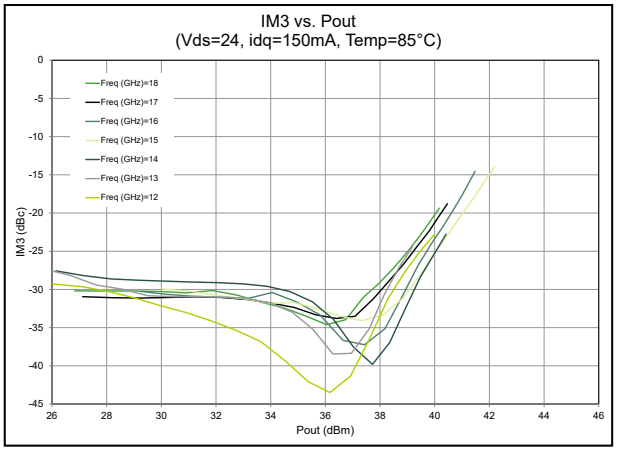




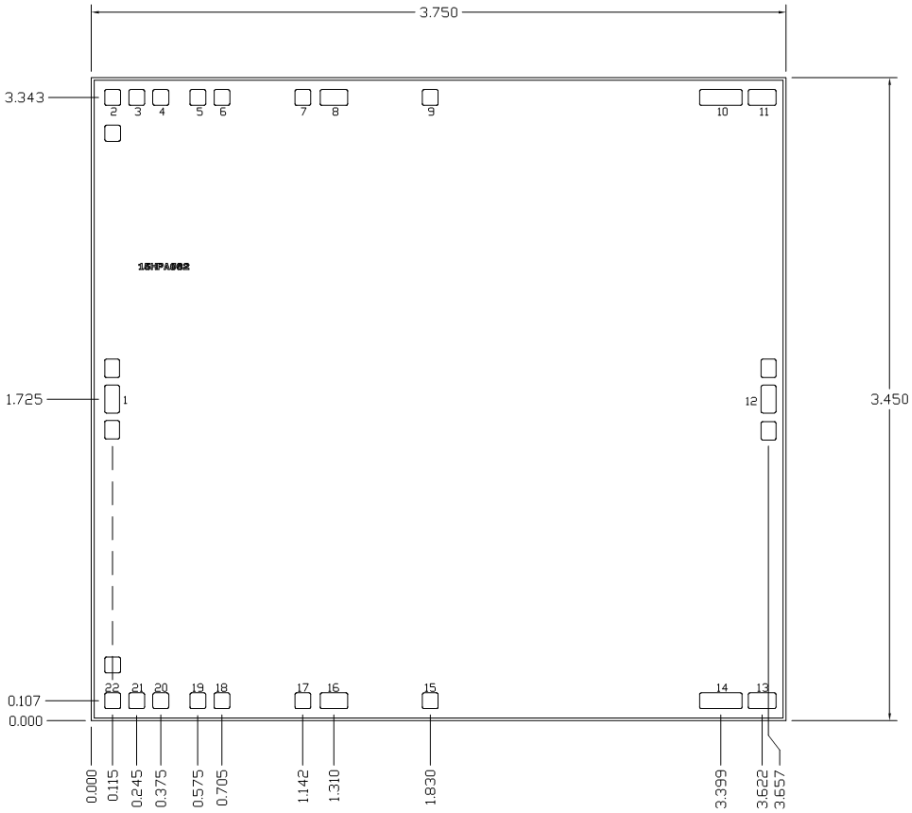








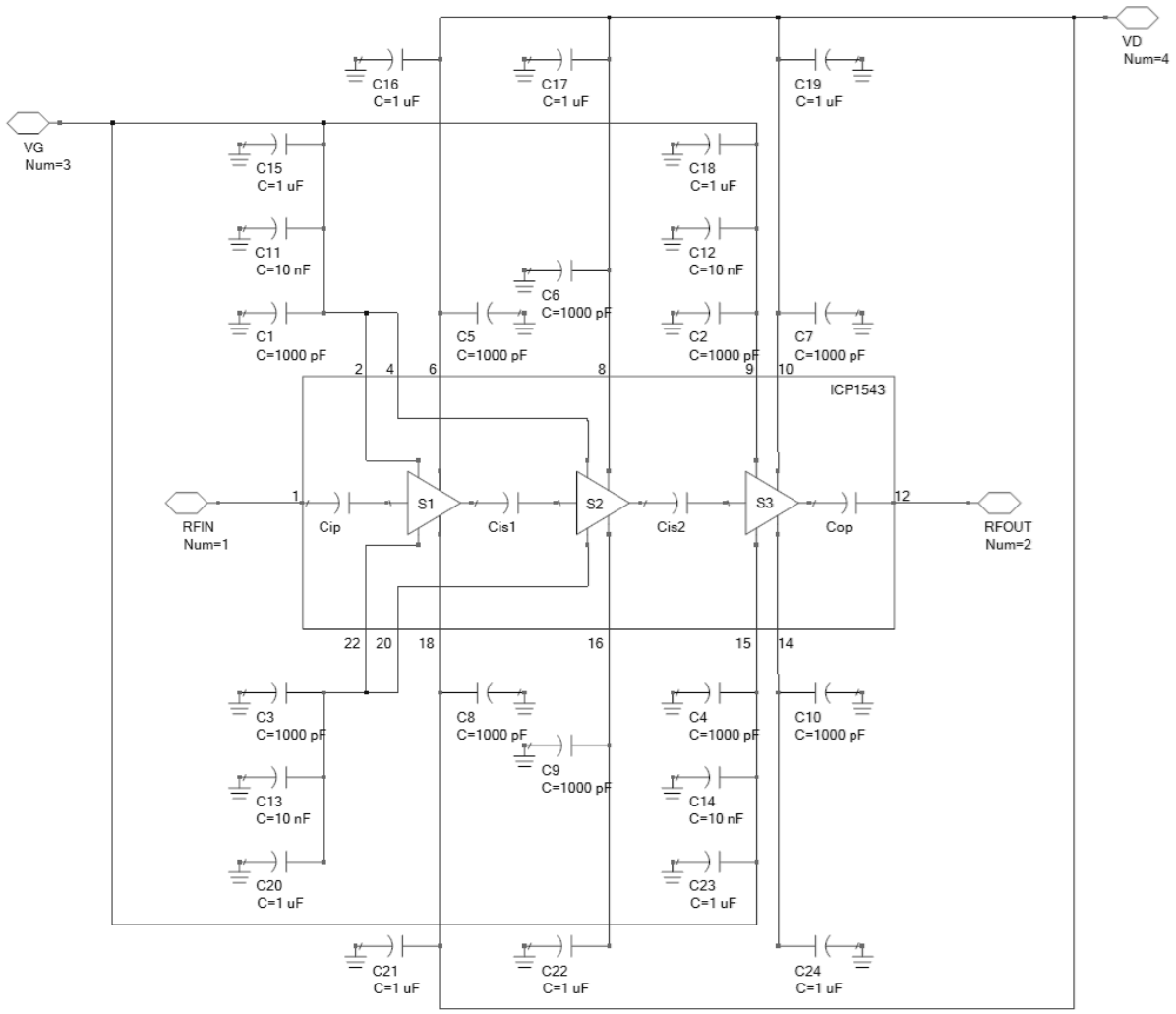
Mechanical Drawing



Units: mm
Thickness: 0.1mm
Backside is RF and DC ground

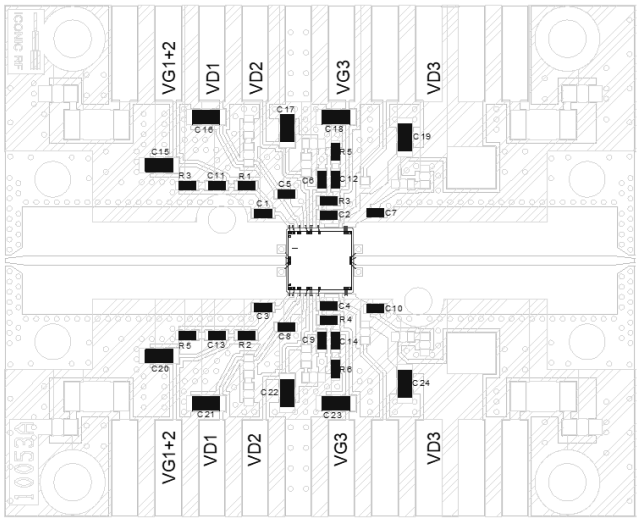
Pad No	Pad Size (um)	Function	Description
1	80x150	RFIN	50 ohm RF input, DC blocked
2,22	85x85	VG1	First stage gate bias, decoupling and bypass caps required, must be biased from both sides
4,20	85x85	VG2	Second stage gate bias, decoupling and bypass caps required, must be biased from both sides
6,18	85x85	VD1	First stage drain voltage, decoupling and bypass caps required, must be biased from both sides
8,16	150x85	VD2	Second stage drain voltage, decoupling and bypass caps required, must be biased from both sides
9,15	85x85	VG3	Third stage gate bias, decoupling and bypass caps required, must be biased from both sides
10,14	230x85	VD3	Third stage drain voltage, decoupling and bypass caps required, must be biased from both sides
12	80x150	RFOUT	50 ohm RF output, DC blocked, pad is DC grounded
3,5,7,17, 19,21	85x85	GND	Topside ground
11,13	150x85	GND	Topside ground

Application Circuit

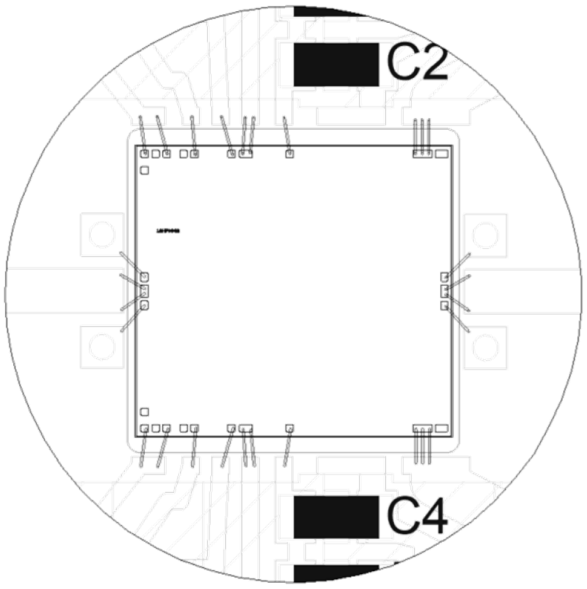


Component ID	Value	Quantity	Description	Manufacturer Part No.
C1-C10	1000pF	10	1000pF Capacitor 0402, COG, 50V	Various
C11-C14	10nF	4	10nF Capacitor 0402, COG, 50V	Various
C15-C24	1uF	10	1uF Capacitor 0603, 35V	Various

Evaluation Circuit Assembly Drawing



Die Bonding



Assembly Guidance

Amplifier must be biased from both sides. Optimum RF power performance achieved by minimizing output RF bond wire length.

Interconnect assembly Notes

- Ball bonding or wedge 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.
- Silver sintered epoxy is recommended -Namics H9890-11, Kyocera CT2700R7S

Die attach of component 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

Bill of Materials

Component ID	Value	Quantity	Description	Manufacturer Part No.
C1-C10	1000pF	10	1000pF Capacitor 0402, COG, 50V	Various
C11-C14	10nF	4	10nF Capacitor 0402, COG, 50V	Various
C15-C24	1uF	10	1uF Capacitor 0603, 35V	Various
R1-R6	0ohm	6	0 ohm resistor 0402 (link)	Various

Bias-Up Procedure

1. Set V_G=-5V
2. Set V_D to 24V
3. Adjust V_G positive until I_D quiescent is 150mA (Typical Vg=-1.9V)
4. Limit I_D to 5A
5. Apply RF Signal

Bias-down Procedure

1. Turn off R_F
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.

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