

7.9-11GHz 12W GaN PA MMIC

Product Overview

ICP1040 is a 2 stage MMIC power amplifier in bare die form, fabricated using GaN on SiC technology. ICP1040 operates from 7.9-11GHz with 41dBm output power, 40% typical PAE and 22dB small signal gain. ICP1040 is well suited to commercial and defense applications.

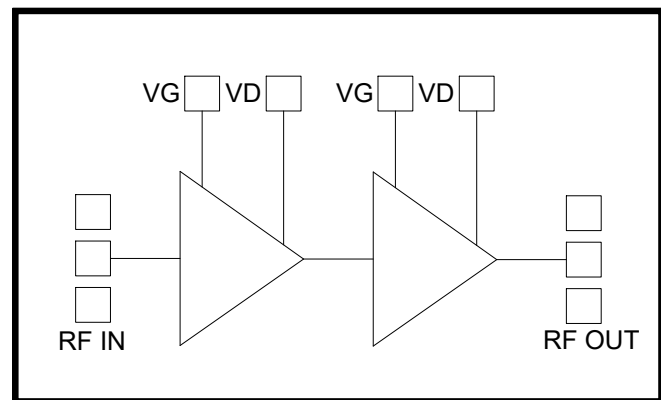
Key Features

- **Frequency Range:** 7.9-11GHz
- **Pout:** 41dBm Pulsed 10% (100µs/1ms)
- **PAE:** 40%
- **Small Signal Gain:** 22dB
- **Bias:** $V_D=28V$, $I_{DQ}=100mA$
- **Technology:** GaN on SiC
- **Lead-free and RoHS compliant**
- **Dimensions:** 3.08mm x 1mm
- **Integrated Power Detector**

Applications

- Commercial Radar
- Satellite Communications
- Aerospace & Defence

Functional Block Diagram



Typical Performances

Parameter	Typical	Units	Conditions ¹
Frequency range	7.9 - 11	GHz	
Saturated Output Power, Psat	41	dBm	Pin=26dBm
Power Added Efficiency, PAE	40	%	Pin= 26dBm
Small Signal Gain, S21	22	dB	
Input Return Loss	-8	dB	
Output Return Loss	-5	dB	

Note: $V_{DQ}=28V$, $I_{DQ}=100mA$, $T_A=25^{\circ}C$, Pulsed 10% (100µs/1ms)

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1. Electrical Specification

1.1 Typical Electrical Performance

Parameter	Min	Typical	Max	Units	Conditions ⁽¹⁾
Frequency	7.9		11	GHz	
Saturated Output Power, P_{sat}		41		dBm	$P_{in}=26\text{dBm}$
Power Added Efficiency, PAE		40		%	$P_{in}=26\text{dBm}$
Small Signal Gain, S_{21}		22		dB	
Input Return Loss		-8		dB	
Output Return Loss		-5		dB	

Note:

1. $V_{DQ}=28\text{V}$, $I_{DQ}=100\text{mA}$, $T_A=25^\circ\text{C}$, Pulsed 10% (100 μs /1ms)

Recommended Operating Conditions

Parameter	Value
Drain Voltage (V_D)	28V
Drain Quiescent Current (I_{DQ})	100mA
Gate Voltage (V_G)	-2.3V to -2.5V

Absolute Maximum Ratings

Parameters	Absolute Maximum
Drain voltage (V_{DG})	30V
Gate voltage range (V_G)	-5V 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 does not recommend sustained operation near these survivability limits.

1.2 Typical RF Performance

1.2.1 Small Signal Performance

Typical Power Data

Test conditions: $V_D=24V$ and $28V$, $I_{DQ}=100mA$

Figure 1-1. S_{21}

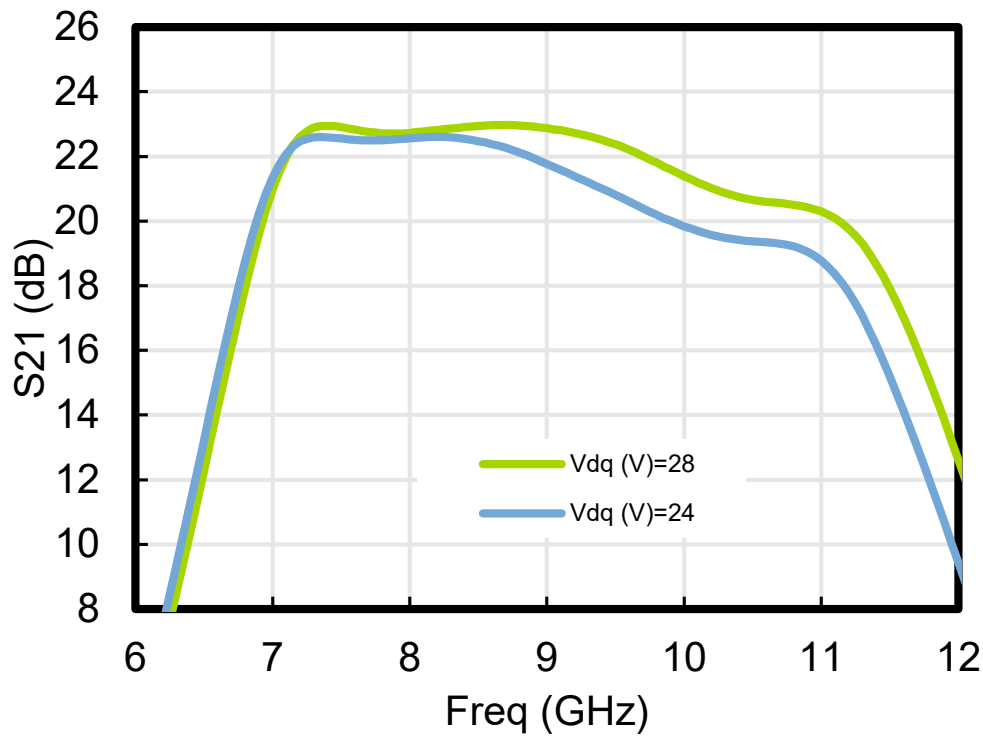


Figure 1-2. S_{11}

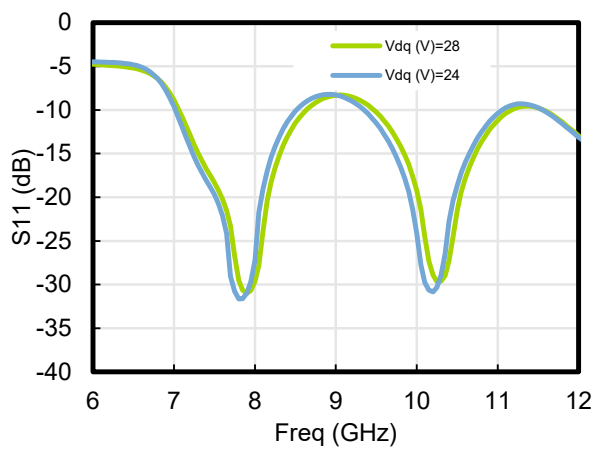
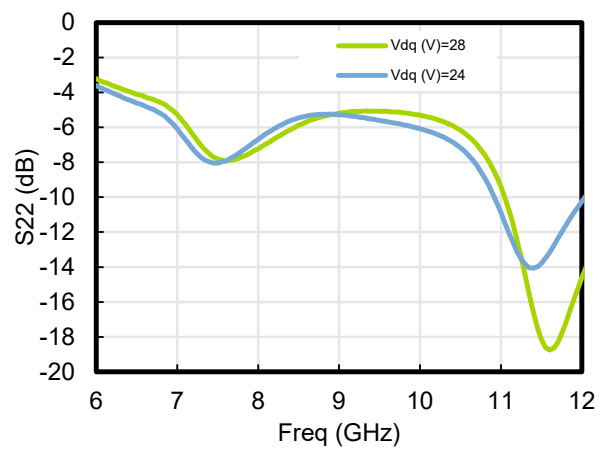


Figure 1-3. S_{22}



1.2.2 Large Signal Performance

Typical Pulsed Power Data

Test conditions: $V_D=28V$, $I_{DQ}=100mA$, Pulsed 10% (100 μs /1ms)

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

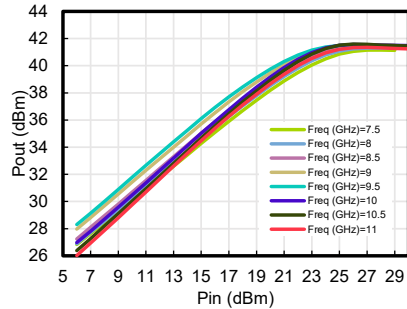


Figure 1-5. Gain vs. P_{out}

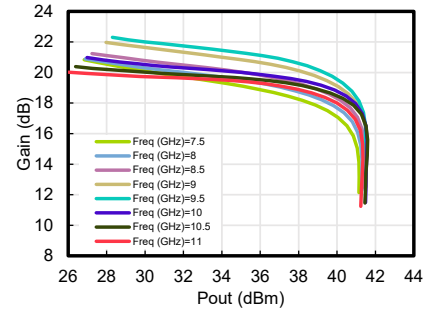


Figure 1-6. PAE vs. P_{out}

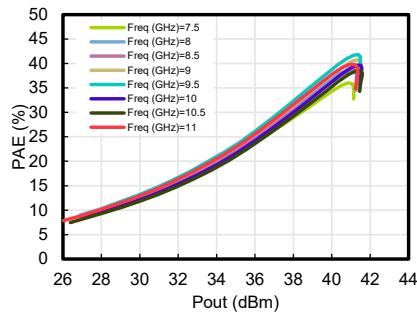


Figure 1-7. I_d vs. P_{out}

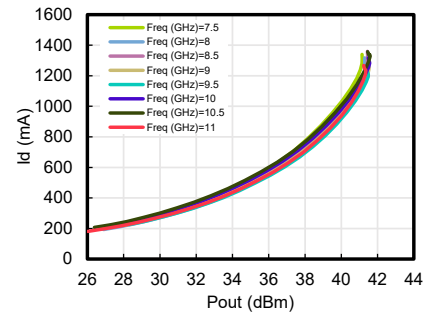


Figure 1-8. P_{out} vs. Freq

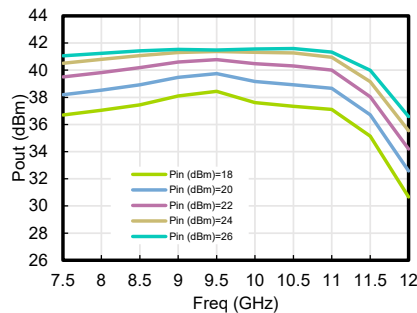


Figure 1-9. Gain vs. Freq

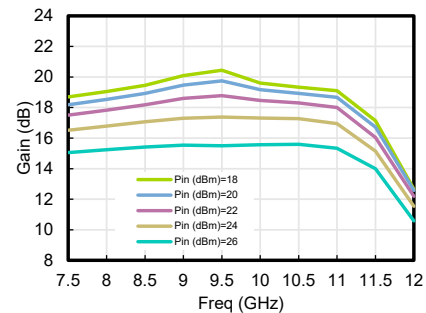


Figure 1-10. PAE vs. Freq

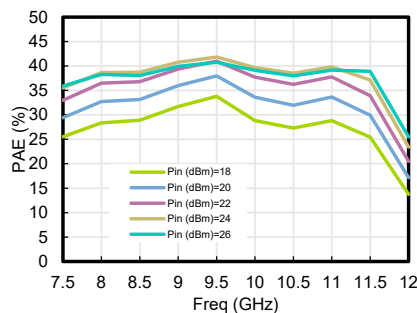
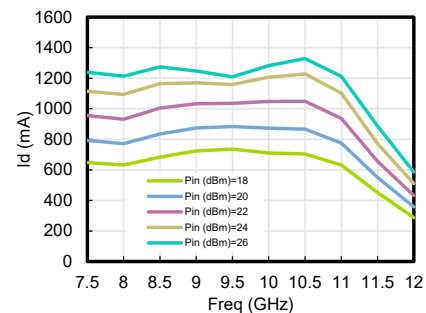


Figure 1-11. I_d vs. Freq



Typical Pulsed Power Data

Test conditions: $V_D=28V$, $I_{DQ}=100mA$, Pulsed 20% (100 μs /500 μs)

Figure 1-12. P_{out} vs. P_{in}

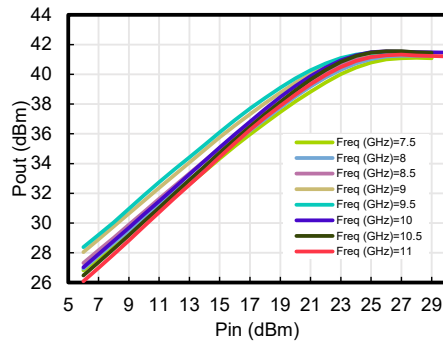


Figure 1-13. Gain vs. P_{out}

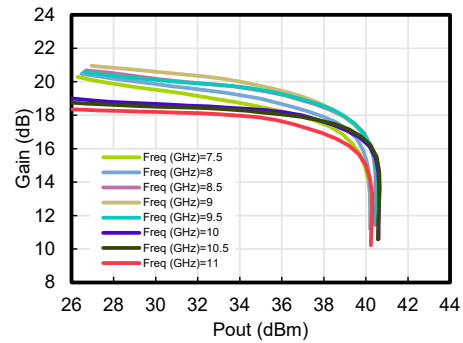


Figure 1-14. PAE vs. P_{out}

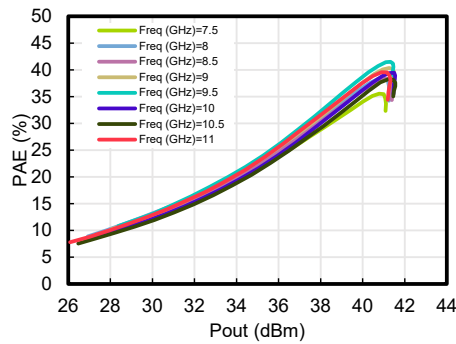


Figure 1-15. I_d vs. P_{out}

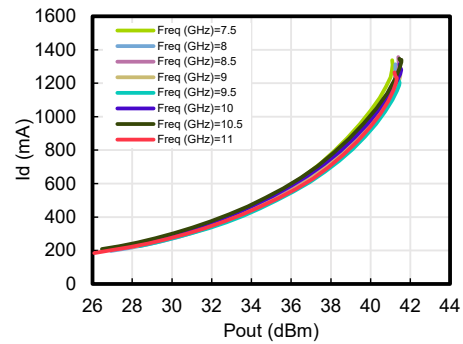


Figure 1-16. P_{out} vs. Freq

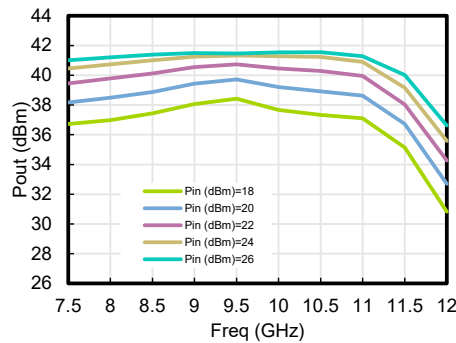


Figure 1-17. Gain vs. Freq

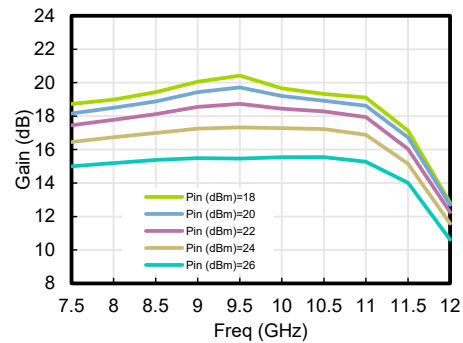


Figure 1-18. PAE vs. Freq

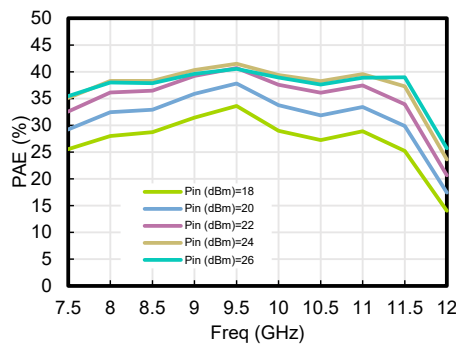
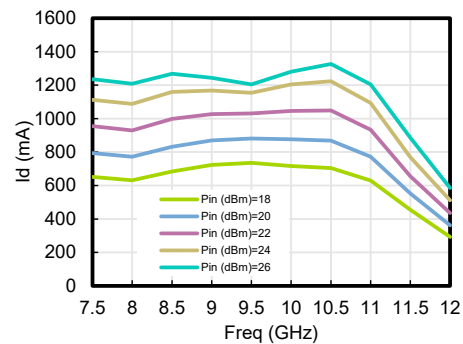


Figure 1-19. I_d vs. Freq



Typical CW Power Data

Test conditions: $V_D=28V$, $I_{DQ}=100mA$, CW

Figure 1-20. P_{out} vs. P_{in}

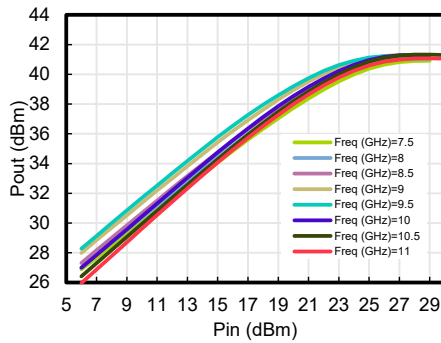


Figure 1-21. Gain vs. P_{out}

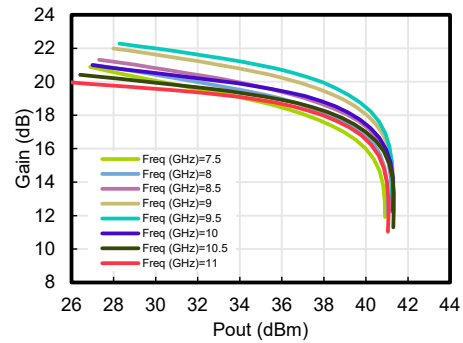


Figure 1-22. PAE vs. P_{out}

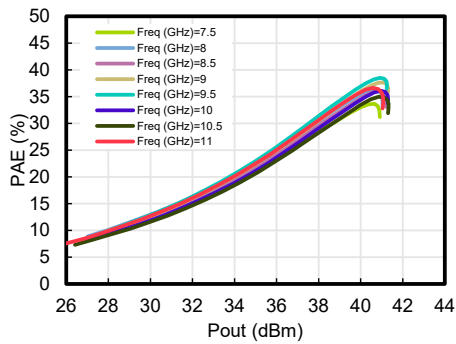


Figure 1-23. I_d vs. P_{out}

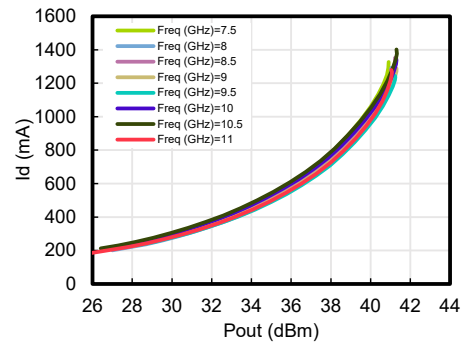


Figure 1-24. P_{out} vs. Freq

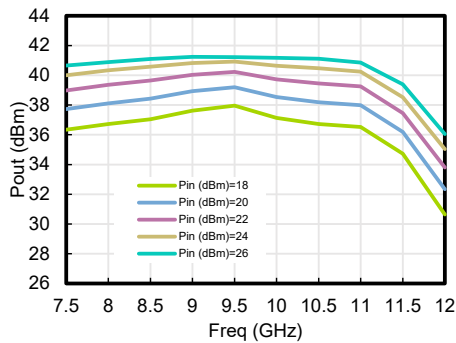


Figure 1-25. Gain vs. Freq

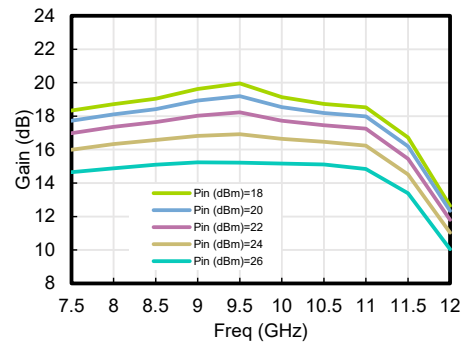


Figure 1-26. PAE vs. Freq

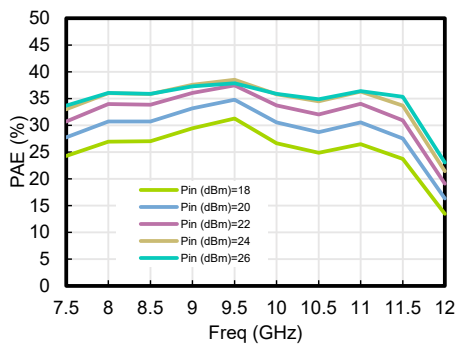
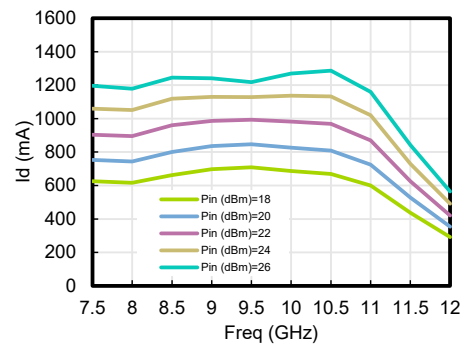


Figure 1-27. I_d vs. Freq



Typical Pulsed Power Data

Test conditions: $V_D=24V$, $I_{DQ}=100mA$, Pulsed 10% (100 μs /1ms)

Figure 1-28. P_{out} vs. P_{in}

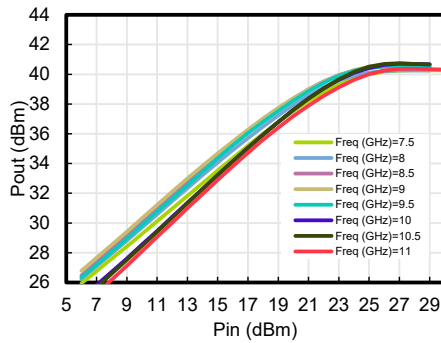


Figure 1-29. Gain vs. P_{out}

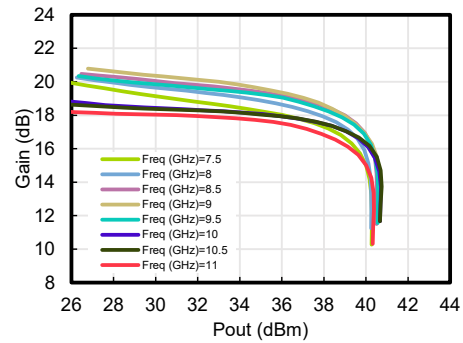


Figure 1-30. PAE vs. P_{out}

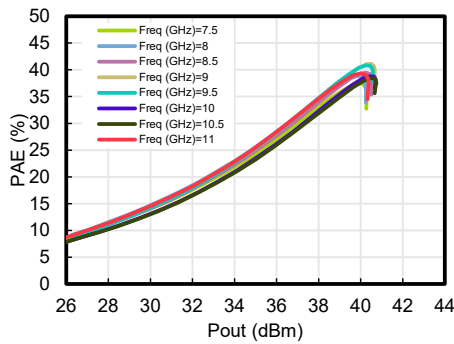


Figure 1-31. I_d vs. P_{out}

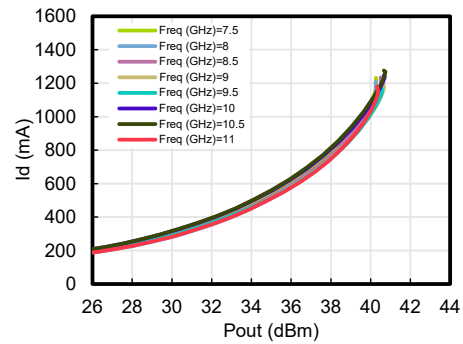


Figure 1-32. P_{out} vs. Freq

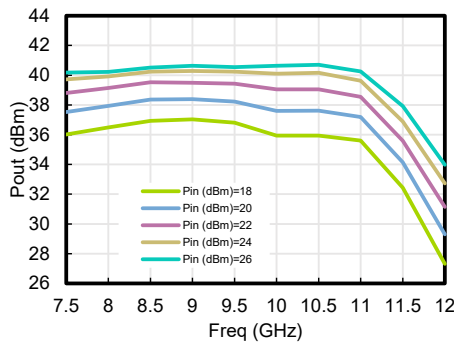


Figure 1-33. Gain vs. Freq

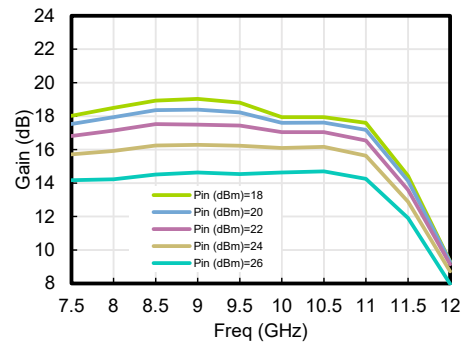


Figure 1-34. PAE vs. Freq

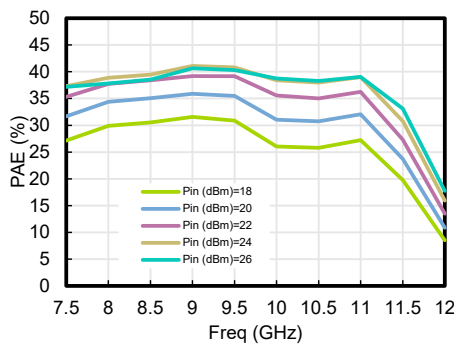
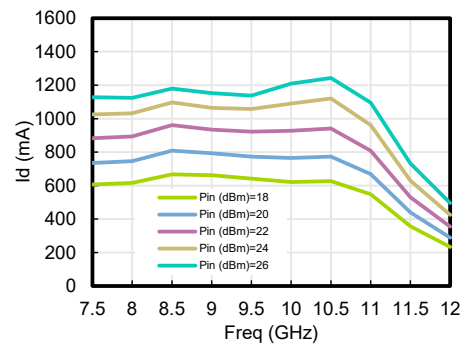


Figure 1-35. I_d vs. Freq



Typical Pulsed Power Data

Test conditions: $V_D=24V$, $I_{DQ}=100mA$, Pulsed 20% (100 μ s/500 μ s)

Figure 1-36. P_{out} vs. P_{in}

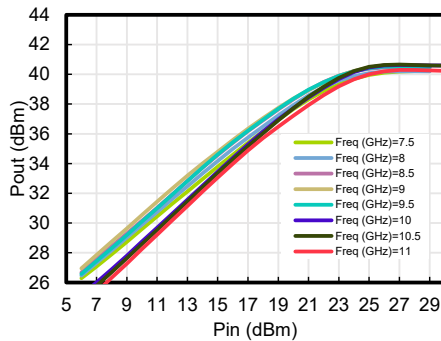


Figure 1-37. Gain vs. P_{out}

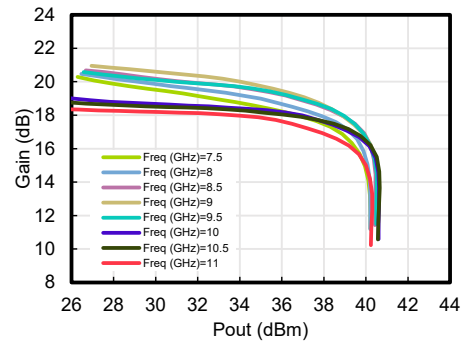


Figure 1-38. PAE vs. P_{out}

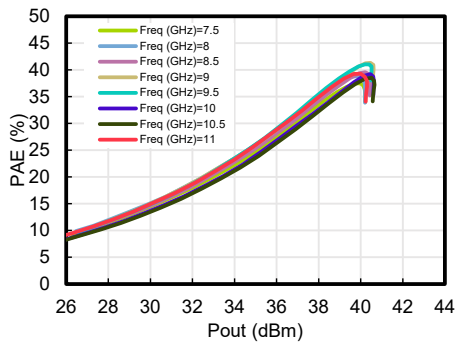


Figure 1-39. I_d vs. P_{out}

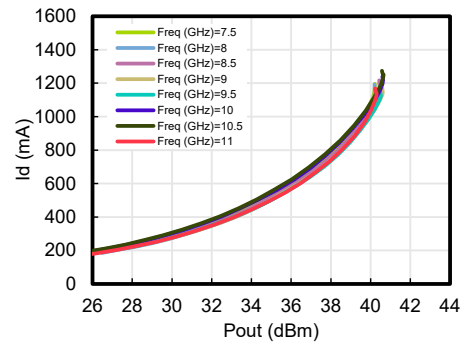


Figure 1-40. P_{out} vs. Freq

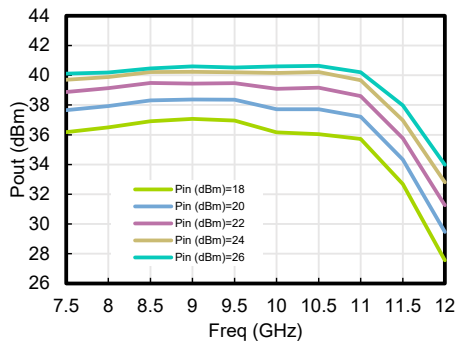


Figure 1-41. Gain vs. Freq

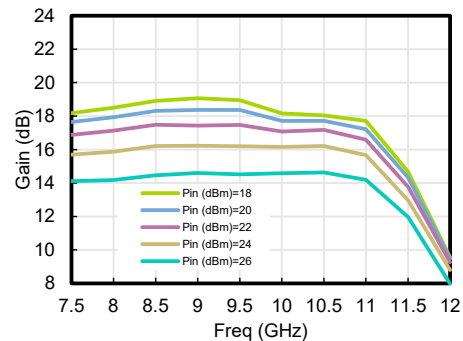


Figure 1-42. PAE vs. Freq

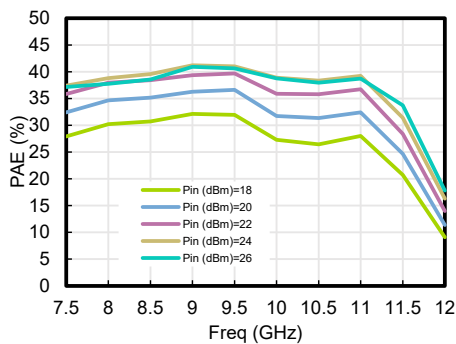
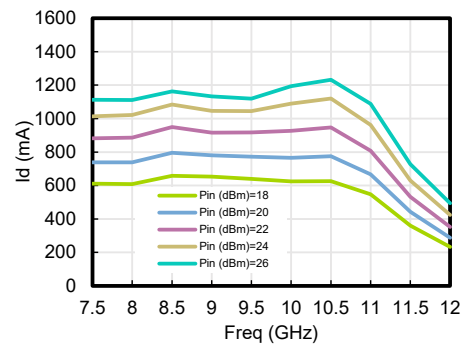


Figure 1-43. I_d vs. Freq



Typical CW Power Data

Test conditions: $V_D=24V$, $I_{DQ}=100mA$, CW

Figure 1-44. P_{out} vs. P_{in}

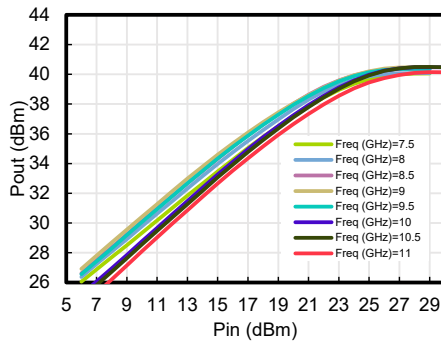


Figure 1-45. Gain vs. P_{out}

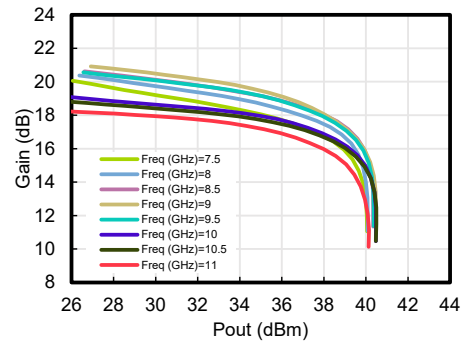


Figure 1-46. PAE vs. P_{out}

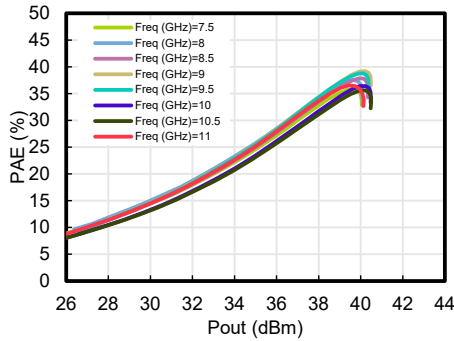


Figure 1-47. I_d vs. P_{out}

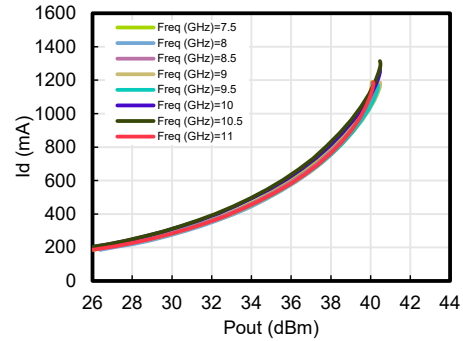


Figure 1-48. P_{out} vs. Freq

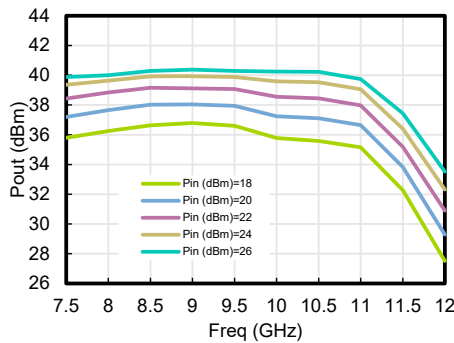


Figure 1-49. Gain vs. Freq

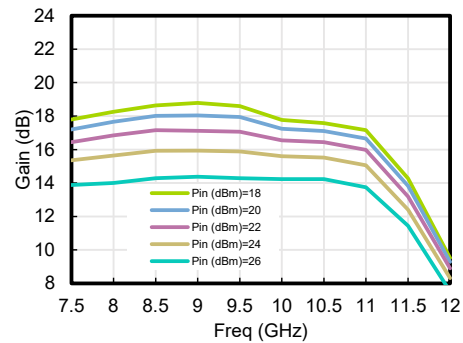


Figure 1-50. PAE vs. Freq

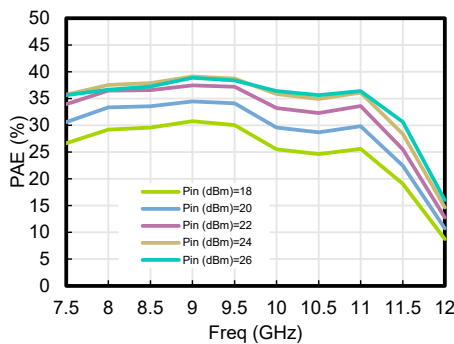
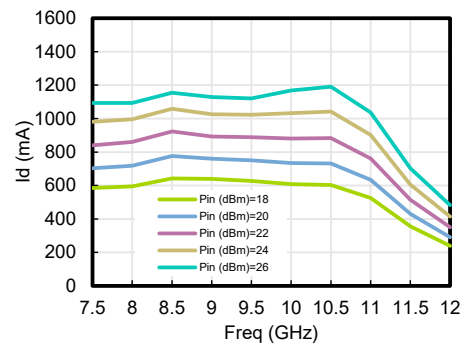


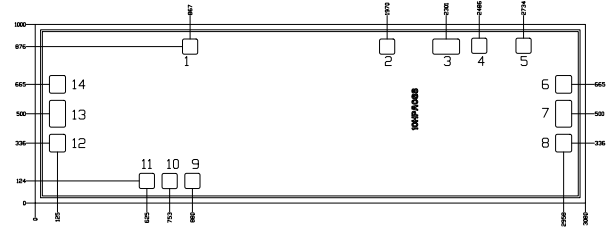
Figure 1-51. I_d vs. Freq



2. Die Specifications

- Units: μm
- Die size tolerance: $\pm 50 \mu\text{m}$
- Backside is RF and DC ground

Figure 2-1. Die Outline Drawing



Pad No.	Function	Description
13	RF _{IN}	RF input, 50 ohm, DC blocked
7	RF _{OUT}	RF output, 50 ohm, DC blocked
1	V _{D1} ⁽¹⁾	1 st stage drain voltage, decoupling and bypass caps required
3	V _{D2} ⁽¹⁾	2 nd stage drain voltage, decoupling and bypass caps required
11	V _{G1} ⁽²⁾	2 nd stage gate bias, decoupling and bypass caps required
9	V _{G2} ⁽²⁾	1 st stage gate bias, decoupling and bypass caps required
4	REF ⁽³⁾	Detector circuit reference voltage
5	DET ⁽³⁾	Detector circuit voltage output
6, 8, 12, 14	GND	Ground connection
2, 10	NC	Not connected

Note:

1. V_{D1} and V_{D2} can be connected together in application.
2. V_{G1} and V_{G2} can be connected together in application.
3. Applications requiring power detector may use this pads, otherwise pins should be NC or Ground

3. 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	Package	Standard Packing Format
ICP1040-1-110I	Die	Gel Pack
ICP1040-1-101I	Die	Wafer on expander ring
ICP1040-1-501U	EVB	EVB - connector SMA

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