CHA6262-99F

17.3-21.5GHz 4W GaN Power Amplifier

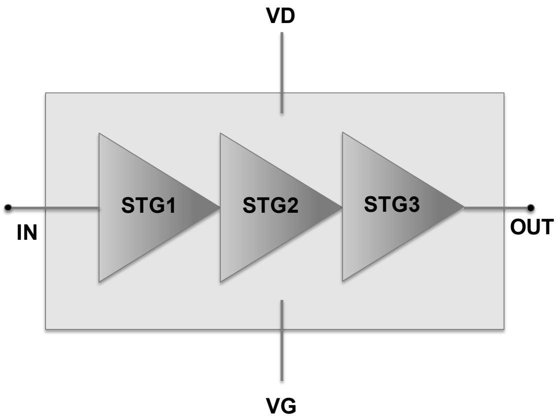
GaN Monolithic Microwave IC

Description

The CHA6262-99F is a three-stage GaN High Power Amplifier operating in the frequency band 17.3-21.5GHz. This HPA typically provides 4W output power associated to 36% of Power Added Efficiency. The circuit exhibits a typical small signal gain of 30dB. The overall power supply is 18V/182mA.

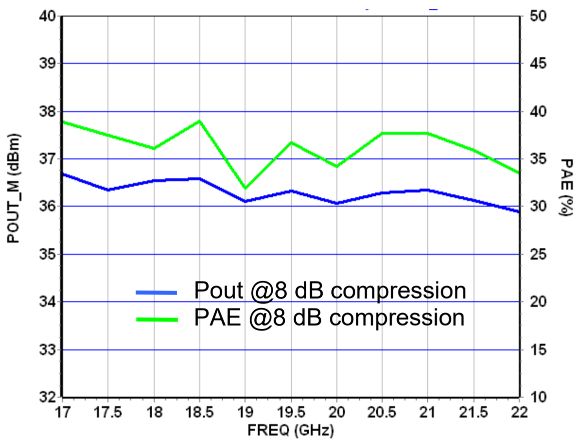
This HPA is dedicated to Space applications and well suited for a wide range of microwave applications and systems.

The product is developed on a robust 0.15µm gate length GaN on SiC HEMT process and is available as a bare die.



Main Features

- 17.3-21.5GHz frequency range
- Linear gain is 30 dB
- P_{out}=36dBm for P_{in}=14dBm
- NPR > 17dB for P_{out} = 2Watts
- PAE=36% at P_{sat}
- DC bias: Vd=18Volts @ Idq=182mA
- Chip size : 3.55mmx2.24mm



Main Electrical Characteristics

T_{case}= +25°C T_{case}: Chip backside temperature

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	17.3		21.5	GHz
Gain	Linear Gain		30		dB
PAE	Power Added Efficiency		36		%
P_{sat}	Saturated Output Power		36		dBm
These values are representative of the measurements done in an evaluation board.					

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Specifications (CW mode)

T_{case}= +25°C, Vd = +18V, Idq=182mA

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	17.3		21.5	GHz
Gain	Linear Gain		30		dB
S_{11}	Input return loss		16		dB
S_{22}	Output return loss		10		dB
P_{sat}	Saturated output Power		36		dBm
NPR	Noise Power Ratio @Pout=2Watt		17		dB
PAE	Power Added Efficiency		36		%
Idq	Quiescent Current		182		mA
Vd	Drain Voltage		18		V

"Power ON" sequence

1. Ground the device
2. Set the gate voltage to -5V
3. Apply the drain voltage Vd (Typically 18V)
4. Increase Vg up to quiescent bias drain current Idq
5. Apply RF signal

"Power OFF" sequence

1. Turn off RF signal
2. Decrease the gate voltage to -5V
3. Decrease the drain voltage to 0V
4. Turn off Vd supply
5. Turn off Vg supply

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Absolute Maximum Ratings [1]

T_{case} = +25°C

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	27	V
Id	Drain bias current (with RF signal at saturation)	1.1	mA
Vg	Gate bias voltage	-7 to -2	V
P_{in}	Maximum input power	20	dBm

(1) Operation of this device above anyone of these parameters may cause permanent damage.

Recommended Operating Range [2], [3]

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	18 to 25	V
Id	Drain bias current (without RF)	182 to 260	mA
Vg	Gate bias voltage	~ -2.5 to ~ -3	V
P_{in}	Maximum input power	18	dBm
Tj	Maximum Junction temperature [4]	200	°C

(2) Electrical performances are defined for specified test conditions

(3) Electrical performances are not guaranteed over all recommended operating conditions

(4) Value is provided for T_{case}=115°C

Temperature Range

T_{case}	Operating temperature range	-40 to +95	°C
T_{stg}	Storage temperature range	-55 to +150	°C

Typical Bias Conditions

T_{case}= +25°C

Symbol	Pad N°	Parameter	Values	Unit
Vg	2, 4, 7, 13	Gate Voltage	~ -2.7	V
Vd	9, 11, 16, 17	Drain Voltage	18	V

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Device thermal performances

The thermal performances of the device are based on UMS rules to evaluate the junction temperature (Tj). This temperature is defined as the peak temperature in the channel area.
This same procedure is the basis for junction temperature evaluation of the samples used to derive the Median lifetime and activation energy for the particular technology on which the CHA6262-99F is fabricated (GaN Power PHEMT 0.15µm).
The temperature is monitored at the backside of the chip (T_{case}).
The system maximum temperature must be adjusted in order to guarantee that junction temperature Tj remains below the maximum value specified in the Recommended Operating Range table. So, the system PCB must be designed to comply with this requirement.
The thermal resistance (R_{TH}) is given in the tables below for the full circuit in CW mode.

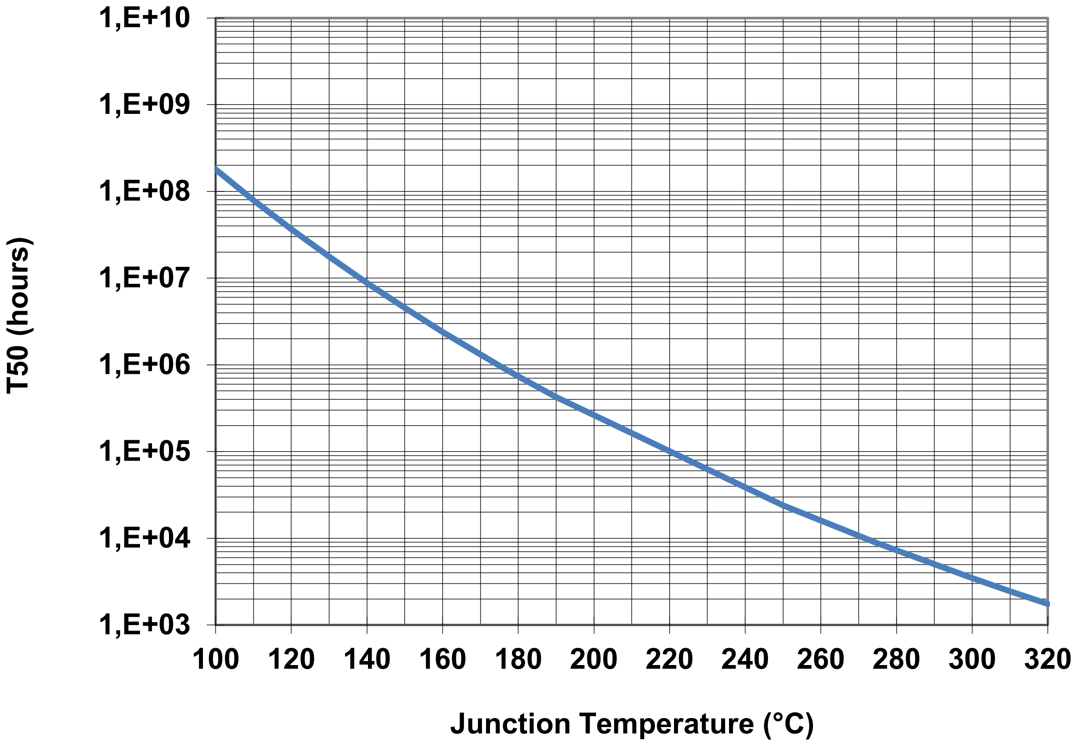
Parameter	Biasing conditions	Tj (°C)	R_{TH} (°C/W)	T50 (hours)
R_{TH} (1) Thermal Resistance (Junction to Case)	Psat=36.3dBm Pdiss= 9.71W CW	195	8.24	3.25E+05

[1] Assuming T_{case} = 115°C

Parameter	Biasing conditions	Tj (°C)	R_{TH} (°C/W)	T50 (hours)
R_{TH} (2) Thermal Resistance (Junction to Case)	Psat=36.6dBm Pdiss= 8.67W CW	153	7.84	3.73E+06

[2] Assuming T_{case} = 85°C

Median Life Time versus Junction Temperature



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Typical Package Sij parameters

T_{case}= +25°C, Vd = +18V, Idq = 182mA

Freq (GHz)	dBS11	PhS11	dBS12	PhS12	dBS21	PhS21	dBS22	PhS22
1	-0.94	-4.83	-77.44	37.93	-74.65	117.98	-0.71	117.23
2	-0.93	-30.17	-69.53	-161.6	-32.95	58.18	-0.7	56.56
3	-0.95	-86.24	-67.59	154.68	-49.63	-0.7	-0.63	-3.37
4	-1	-147.86	-67.19	-126.51	-48.18	-60.91	-0.61	-63.64
5	-1.25	146.74	-67.01	134.85	-33.93	-124.12	-0.66	-125.79
6	-1.63	118.92	-72.04	-33.53	-23.12	167.67	-0.83	169.36
7	-1.98	134.3	-81.6	-162.84	-29.88	92.07	-1.08	101.27
8	-2.38	-0.05	-82.1	108.61	-35.87	5.37	-1.56	28.14
9	-3.01	-162.64	-63.52	131.37	-47.14	-101.05	-3.88	-50.77
10	-3.28	107.93	-59.29	106.79	-30.56	129.97	-5.76	-86.55
11	-2.97	39.6	-57.9	-12.12	-25.28	11.51	-2.71	-161.42
12	-3.1	-37.88	-59.32	-103.05	-29.82	-79.82	-1.85	110.96
13	-3.65	-31.99	-65.73	-48.82	-33.43	-156.93	-1.62	11.62
14	-4.59	-87.94	-57.97	-38.51	-9.89	130.36	-2.38	-98.82
15	-6.56	-74.63	-68.73	-164.64	11.09	60.49	-4.45	147.78
16	-8.55	-110.86	-50.5	34.82	25.96	-9.8	-7.42	28.14
17	-21.82	158.45	-47.79	-154.06	30.06	-97.09	-21.59	-124.08
18	-20.12	105.85	-47.56	64.78	29.72	-80.74	-25.98	145.4
19	-18.19	32.08	-48.64	-69.35	29.51	121.52	-12.16	63.75
20	-16.61	-4.39	-52.87	170.55	29.08	20.96	-8.62	-21.51
21	-20.54	-26.43	-52.02	50.05	30.47	-53.85	-8	-104.67
22	-11.9	-90.46	-50.73	-94.94	31.37	-22.03	-14.3	134.42
23	-5.91	-132.86	-54.95	119.41	29.52	-96.73	-13.07	-45.69
24	-3.93	-126.93	-58.6	-51.47	26.82	-165.81	-6.18	-122.92
25	-2.54	-132.34	-48.6	142.44	13.28	127.59	-3.25	157.78
26	-1.86	165.98	-43.17	24.67	-1.9	55.27	-2.46	84.78
27	-1.5	88.14	-40.28	-74.67	-18.4	-16.22	-2.05	11.35
28	-1.21	27.28	-40.41	12.21	-50.97	-83.24	-1.63	-61.16
29	-1.06	-50.26	-41.18	-60.44	-35.1	-143.59	-1.22	-126.47
30	-0.83	-93.99	-46.02	-121.63	-39.72	161.99	-0.87	175.17
31	-0.71	-161.49	-46.75	175.52	-40.74	109.41	-0.77	121.4
32	-0.7	129.48	-51.73	105	-45.45	56.88	-0.72	69.66
33	-0.73	150.08	-70.34	41.68	-56	1.27	-0.75	16.58
34	-0.78	137.93	-63.91	-102.36	-61.93	-58.05	-0.69	-38.54
35	-0.84	33.97	-71.4	-178.9	-58.15	-117.21	-0.76	-94.9
36	-0.82	174.87	-49.31	167.68	-50.41	-172.48	-0.73	-150.68
37	-0.71	137.65	-42.86	134.01	-43.49	137.66	-0.69	156.2
38	-0.64	58.57	-40.81	54.29	-40.14	91.51	-0.67	106.76
39	-0.63	-4.68	-37.92	-5.34	-37.94	45.8	-0.7	57.53
40	-0.69	-56.18	-37	-59.52	-37.04	-0.63	-0.83	7.25

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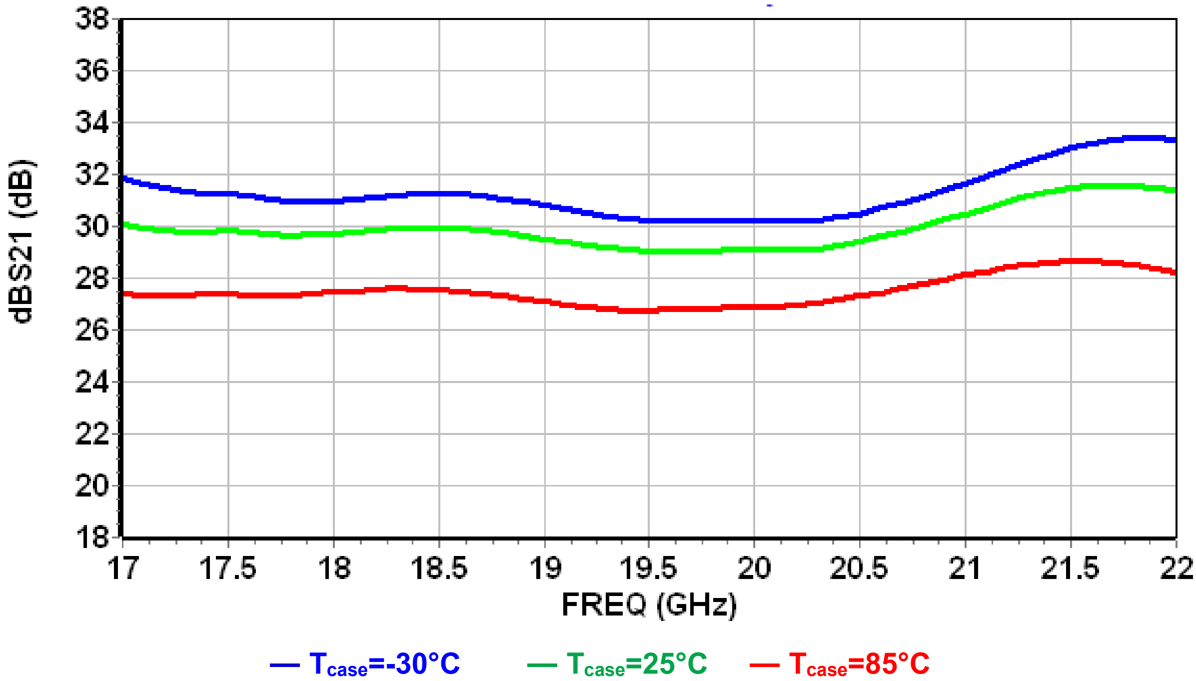
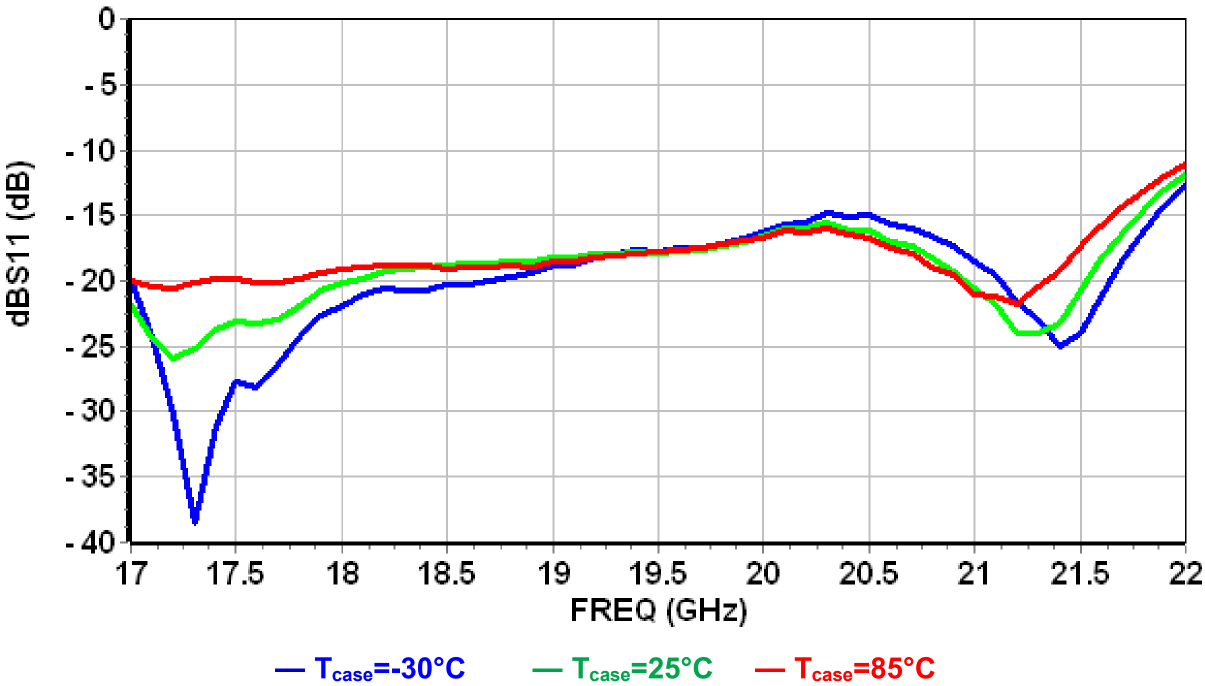
Typical Test Fixture Measurements : Small Signal Performances

T_{case}= -30°C / 25°C / 85°C (Chip Backside), Vd = +18V, Idq = 182mA (Adjusted at T_{case}=25°C).

Linear Gain versus Frequency & temperature



Input Return Losses versus Frequency & temperature



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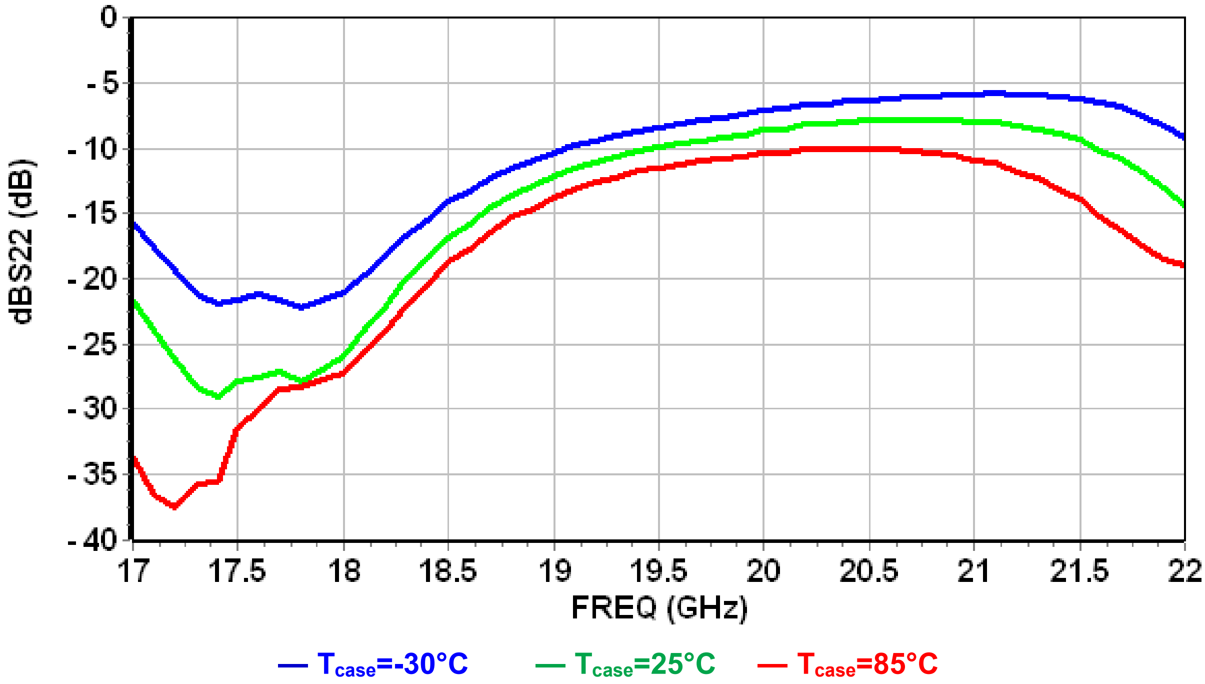
Typical Test Fixture Measurements : Small Signal Performances

T_{case}= -30°C / 25°C / 85°C (Chip Backside), Vd = +18V, Idq = 182mA (Adjusted at T_{case}=25°C).

Output Return Losses versus Frequency & temperature



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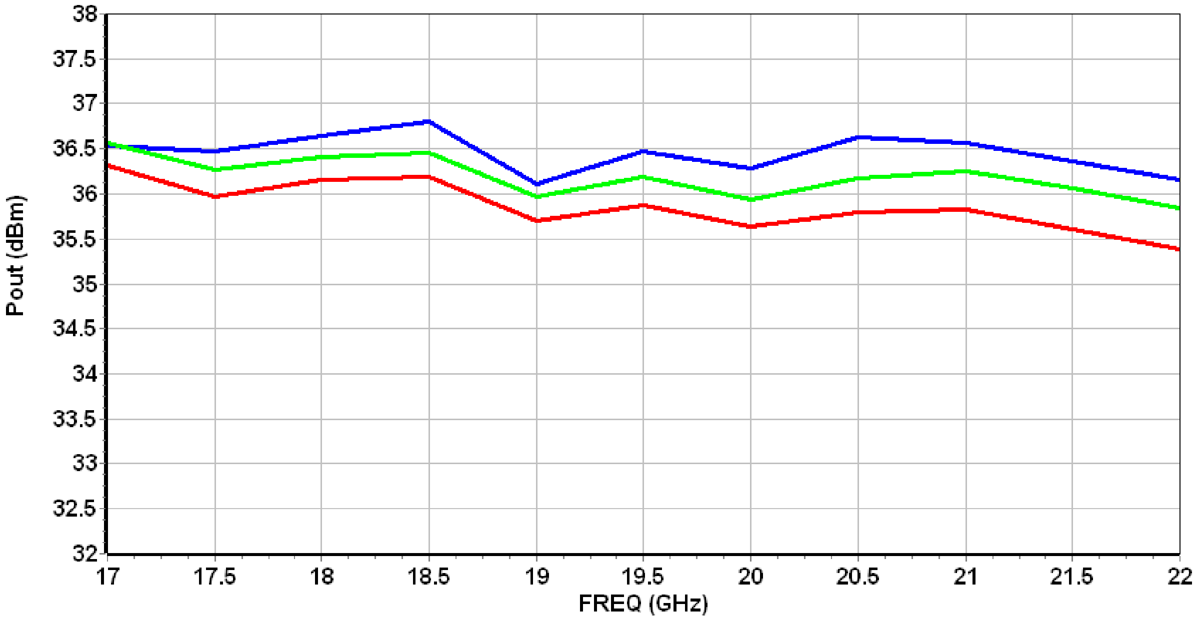
Typical Test Fixture Measurements : Non-linear performances

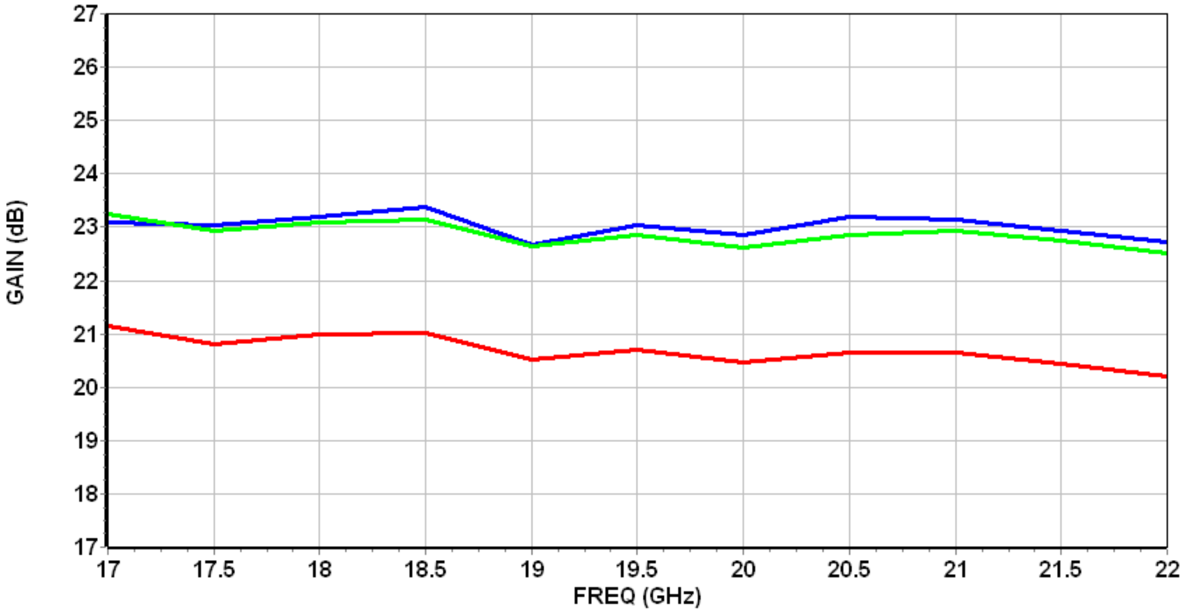
CW measurements: P_{in}=14dBm, Vd = +18V, Idq = 182mA (Adjusted at T_{case}=25°C).

Output power versus Frequency & temperature



— T_{case}=-30°C — T_{case}=25°C — T_{case}=85°C

Gain versus Frequency & temperature



— T_{case}=-30°C — T_{case}=25°C — T_{case}=85°C

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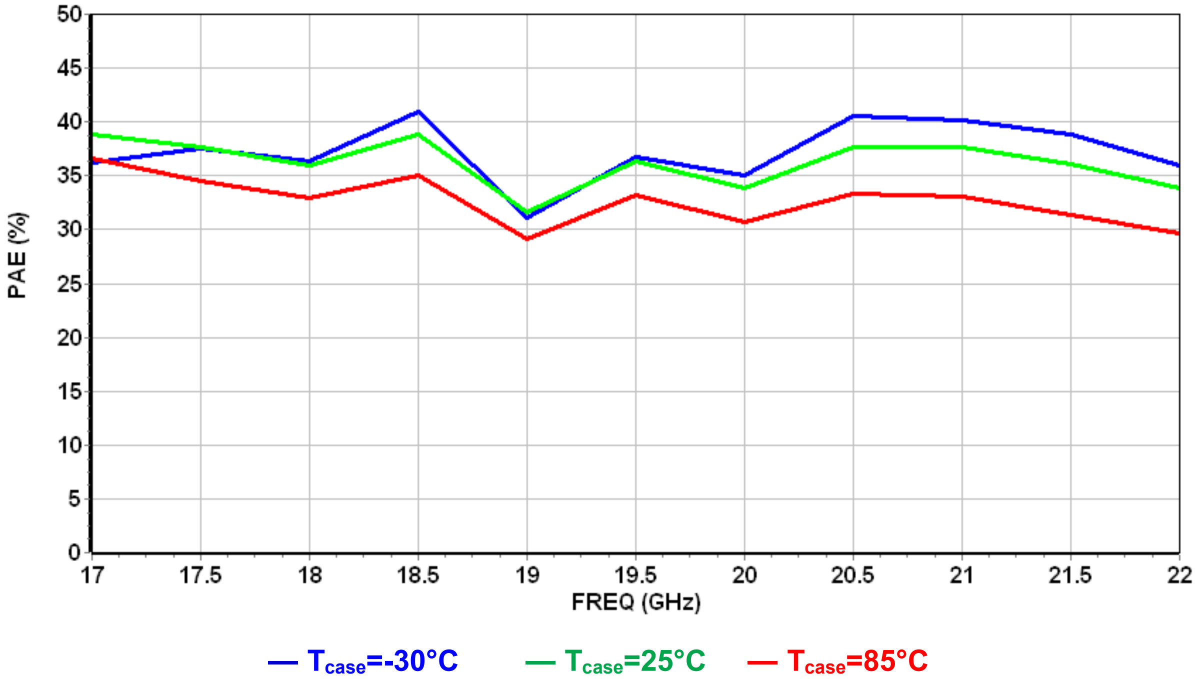
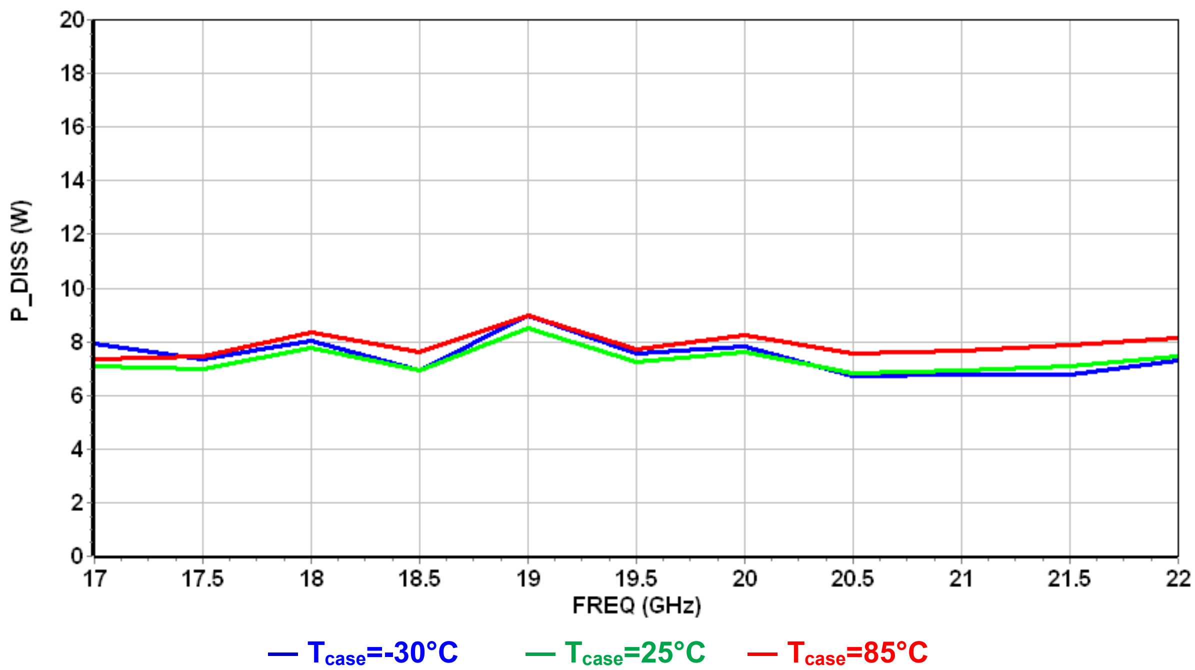
Typical Test Fixture Measurements : Non-linear performances

CW measurements: P_{in}=14dBm, Vd = +18V, Idq = 182mA (Adjusted at T_{case}=25°C).

Power Added Efficiency vs Frequency & temperature



Dissipated Power versus Frequency & temperature



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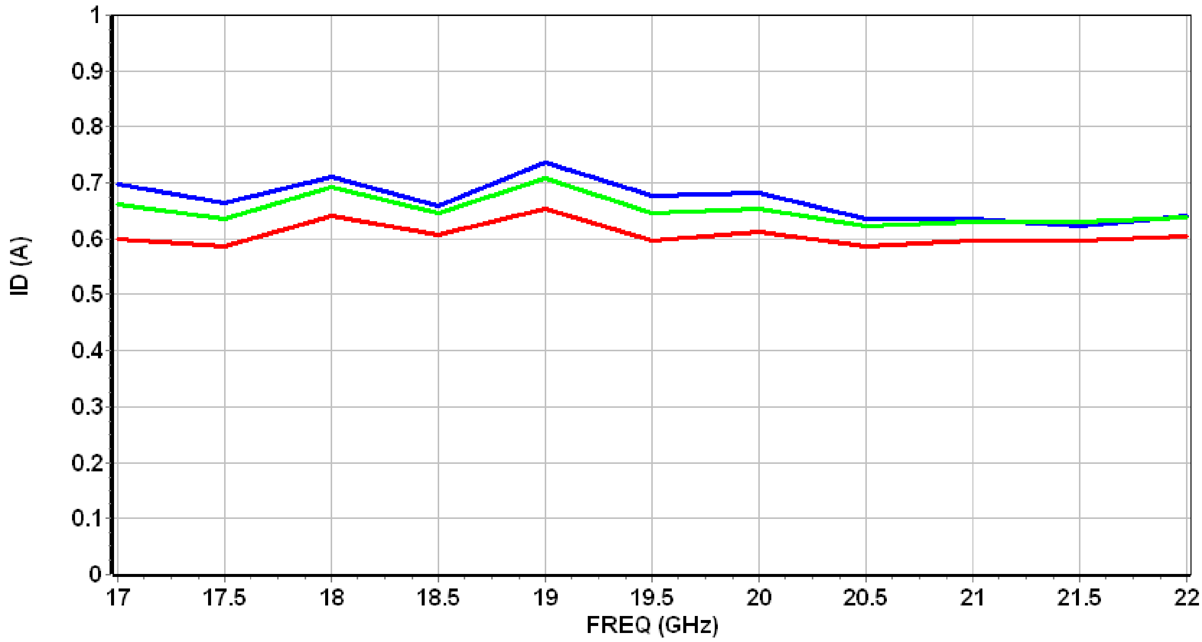
Typical Test Fixture Measurements : Non-linear performances

CW measurements: P_{in}=14dBm, Vd = +18V, Idq = 182mA (Adjusted at T_{case}=25°C).

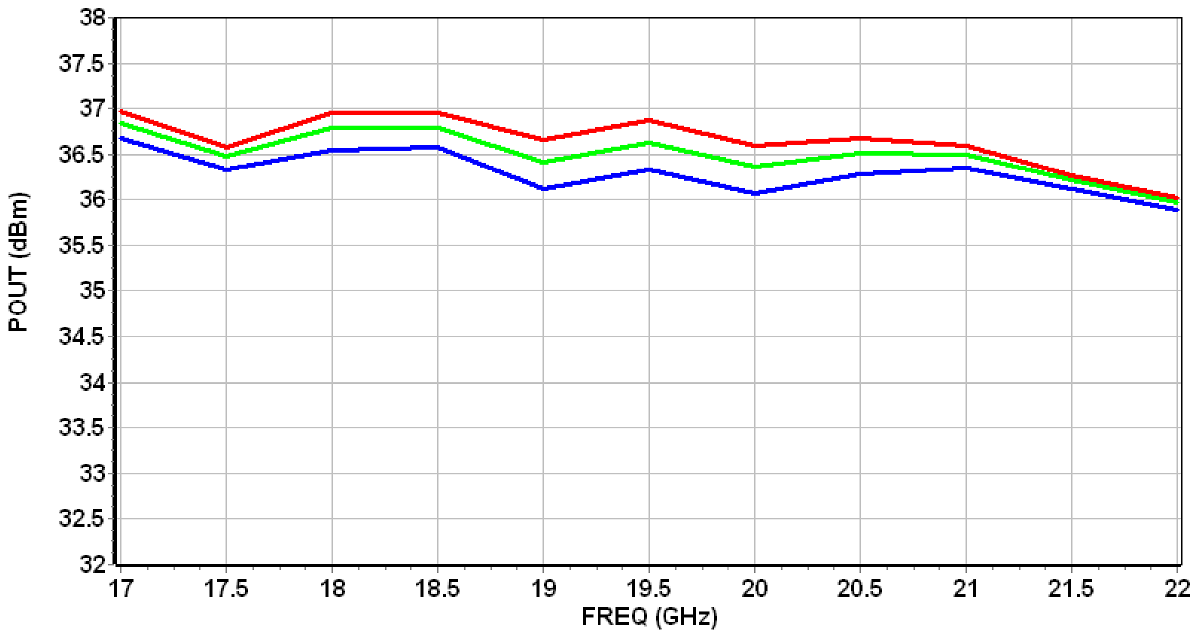
Drain current vs Frequency & temperature



— T_{case}=-30°C — T_{case}=25°C — T_{case}=85°C

Output power versus Frequency & Input Power

CW measurements: T_{case}=+25°C, Vd = +18V, Idq = 182mA (Adjusted at T_{case}=25°C).



— P_{in}=14dBm — P_{in}=15dBm — P_{in}=16dBm

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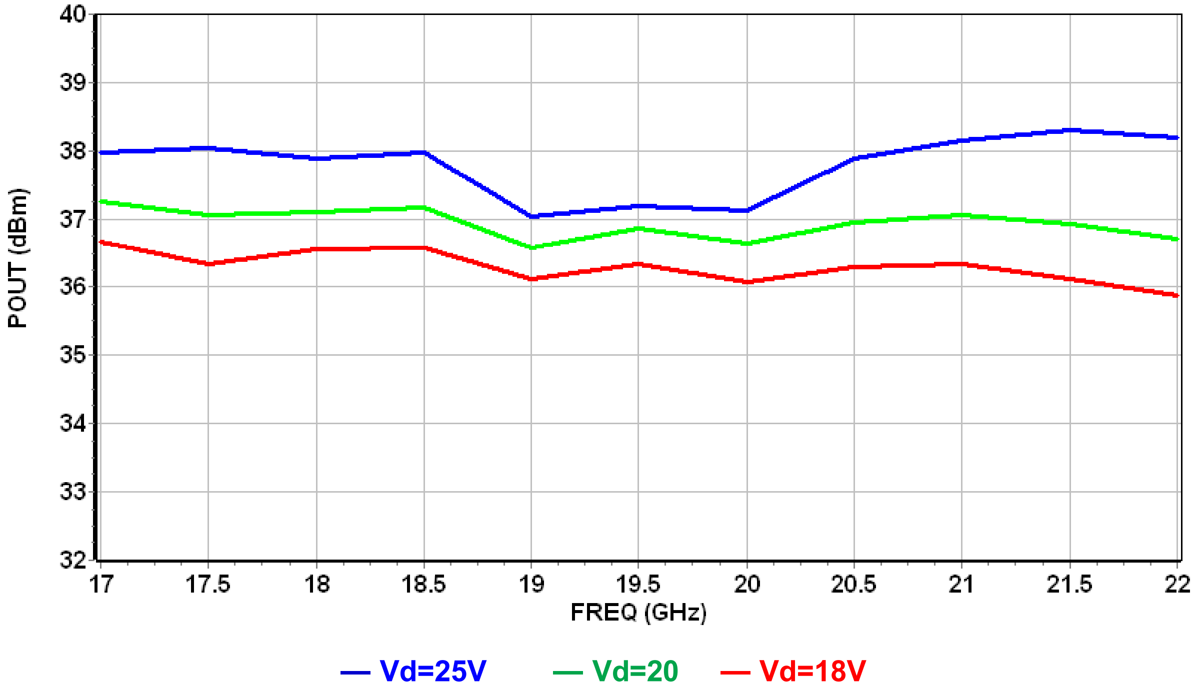
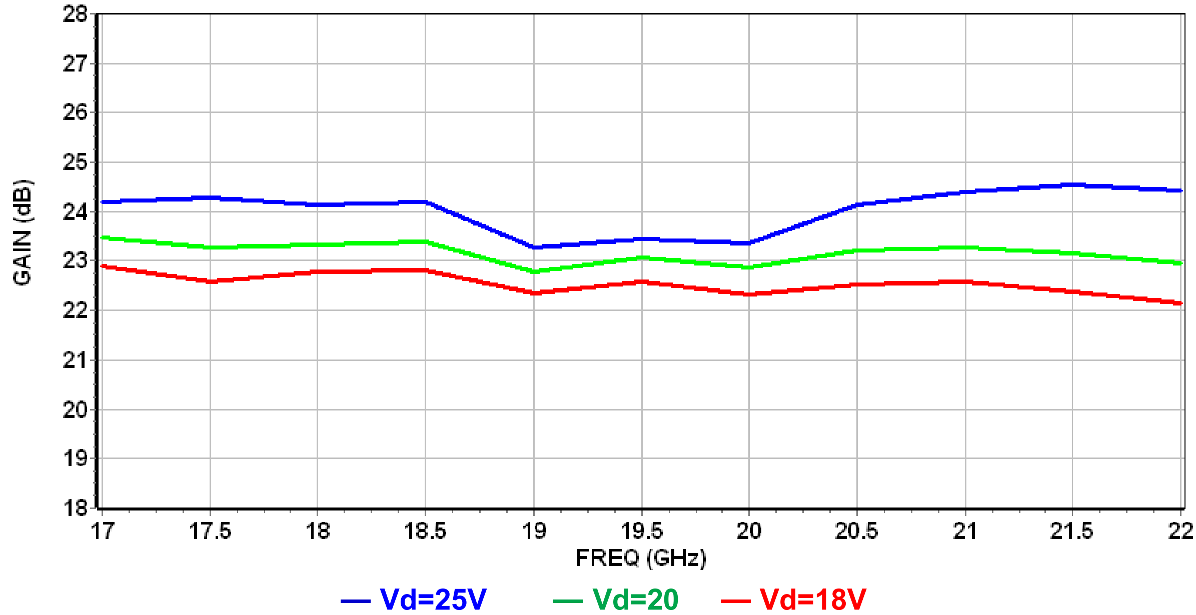
Typical Test Fixture Measurements : Non-linear performances

CW measurements: T_{case}=+25°C, P_{in}=14dBm, Idq = 182mA (Adjusted at T_{case}=25°C).

Output Power vs Frequency & Drain Voltage



Gain versus Frequency & Drain Voltage



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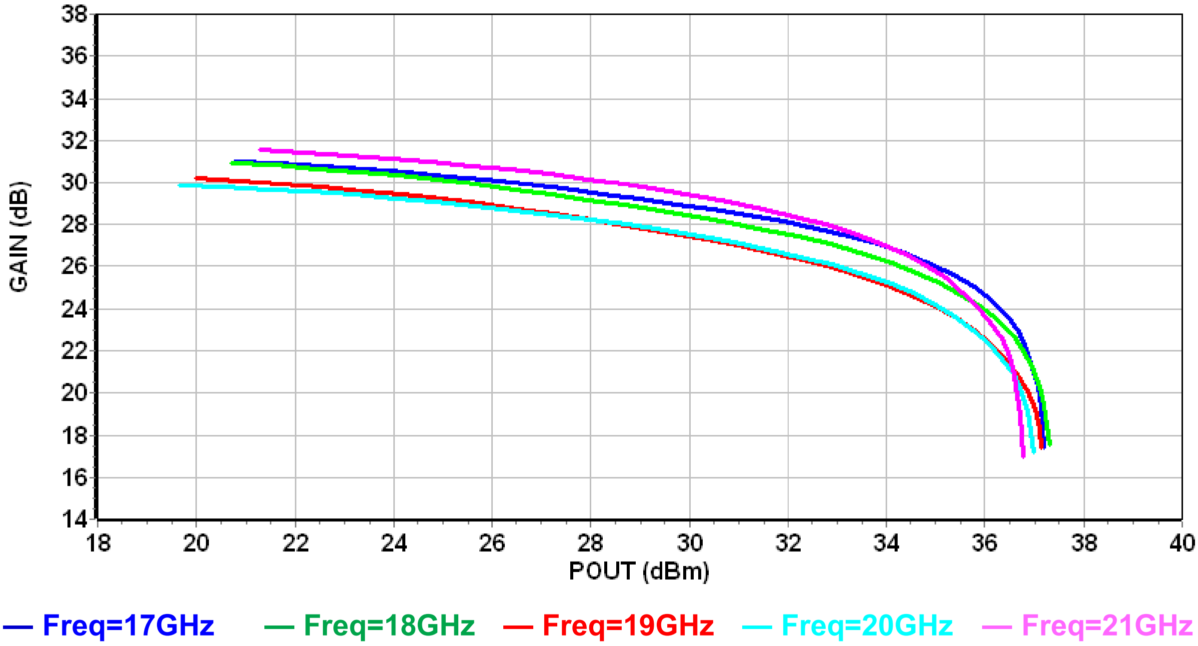
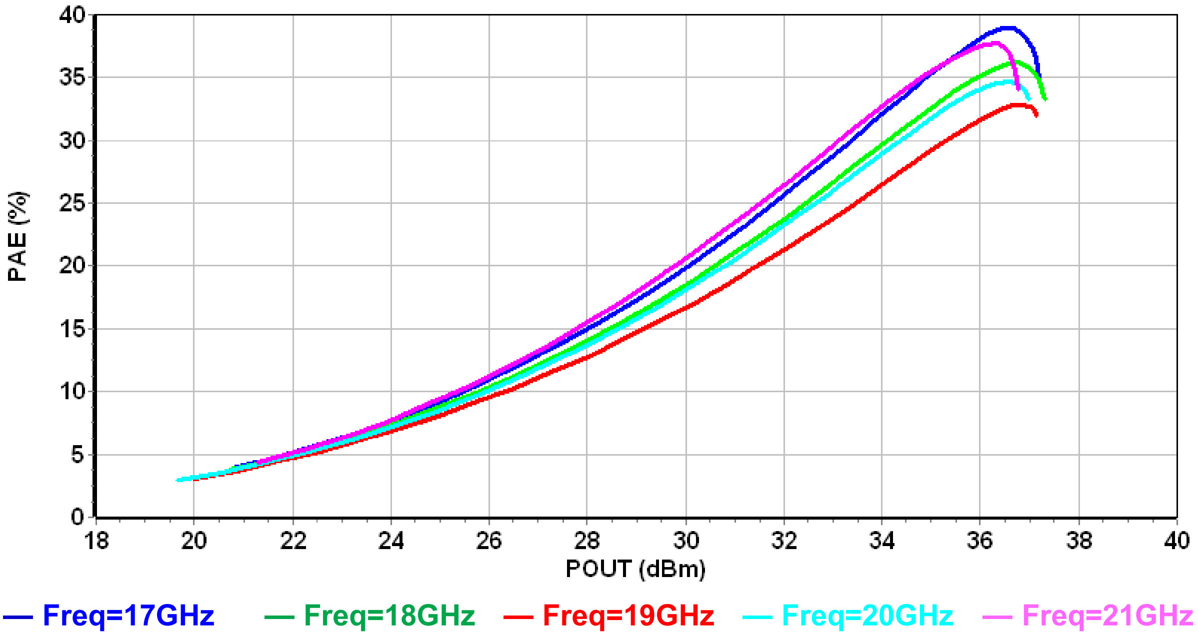
Typical Test Fixture Measurements : Non-linear performances

CW measurements: T_{case}=+25°C, Vd = +18V, Idq = 182mA (Adjusted at T_{case}=25°C).

Gain versus Output Power & Frequency



Power Added Efficiency versus Output Power & Frequency



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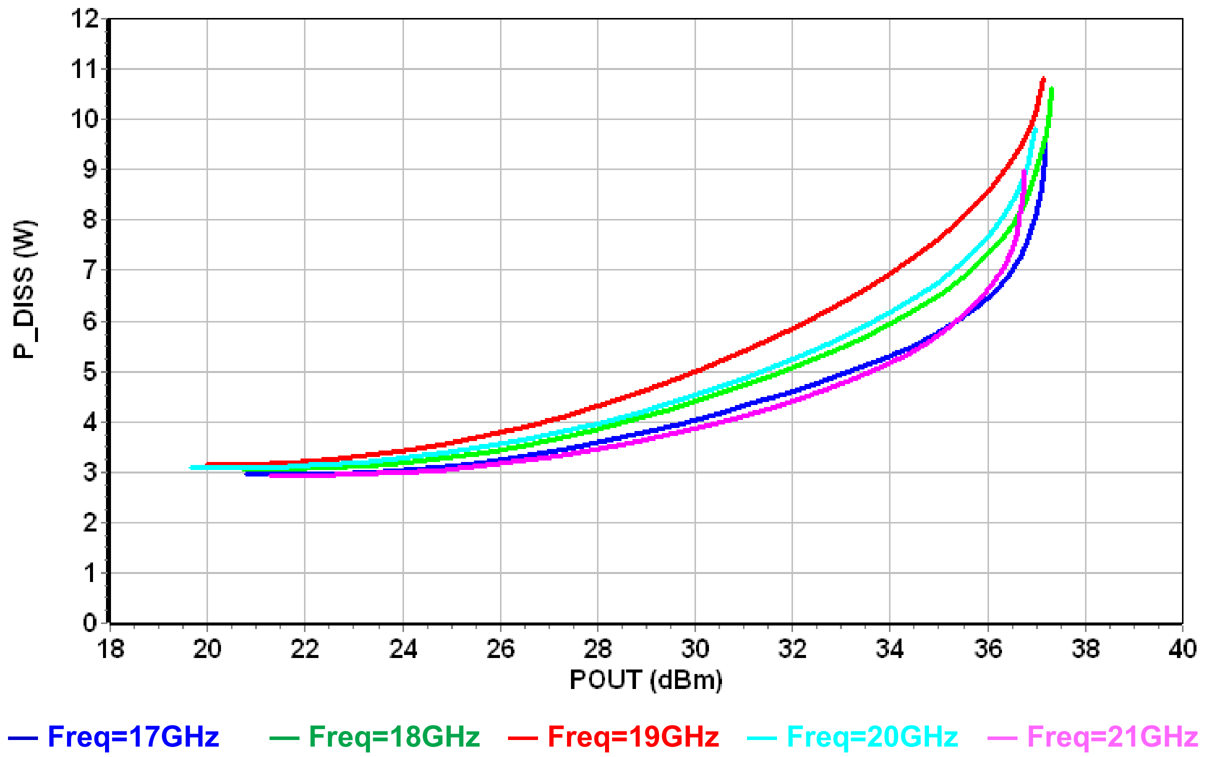
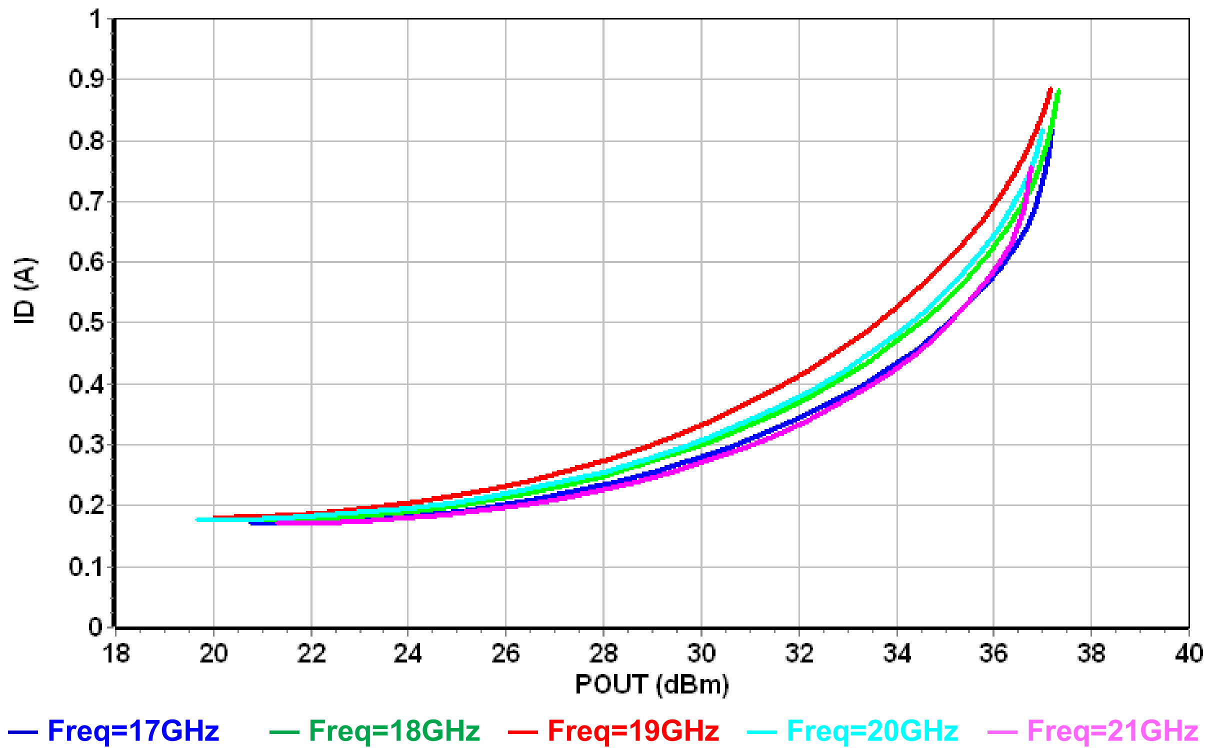
Typical Test Fixture Measurements : Non-linear performances

CW measurements: T_{case}=+25°C, Vd = +18V, Idq = 182mA (Adjusted at T_{case}=25°C).

Dissipated Power versus Output Power & Frequency



Drain Current versus Output Power & Frequency



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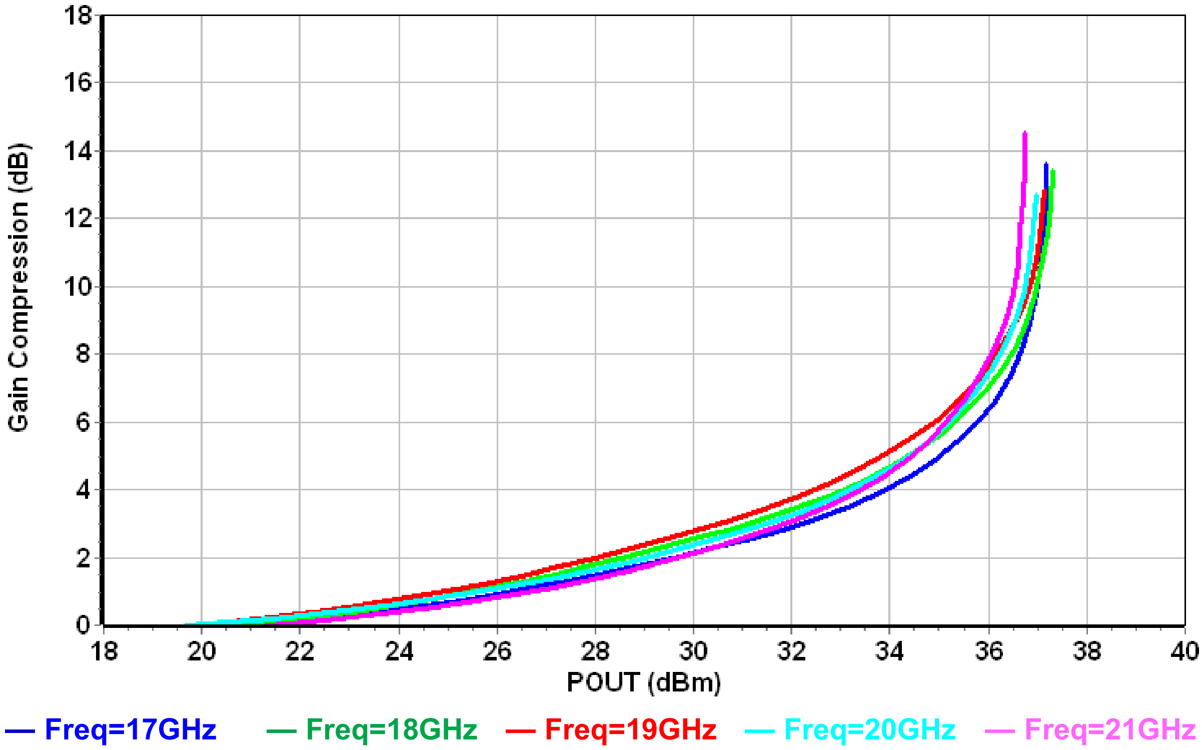
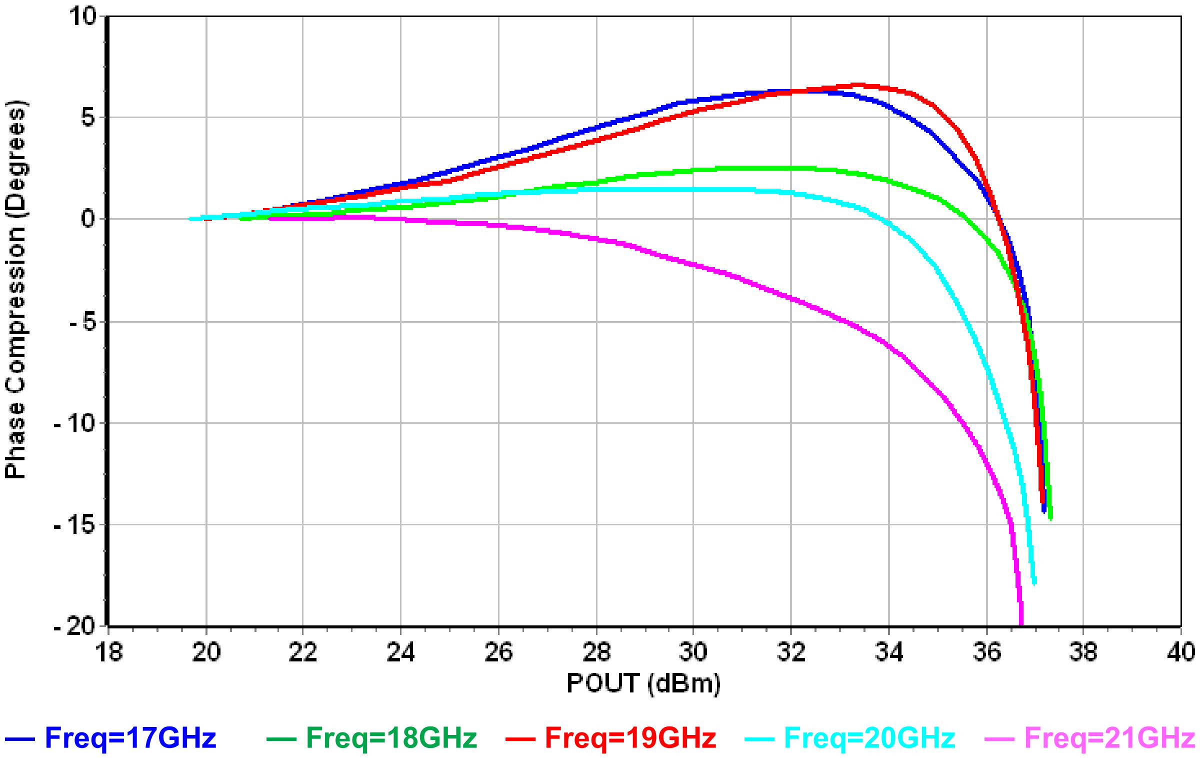
Typical Test Fixture Measurements : Non-linear performances

CW measurements: T_{case}=+25°C, Vd = +18V, Idq = 182mA (Adjusted at T_{case}=25°C).

Gain Compression versus Output Power & Frequency



Phase Compression versus Output Power & Frequency



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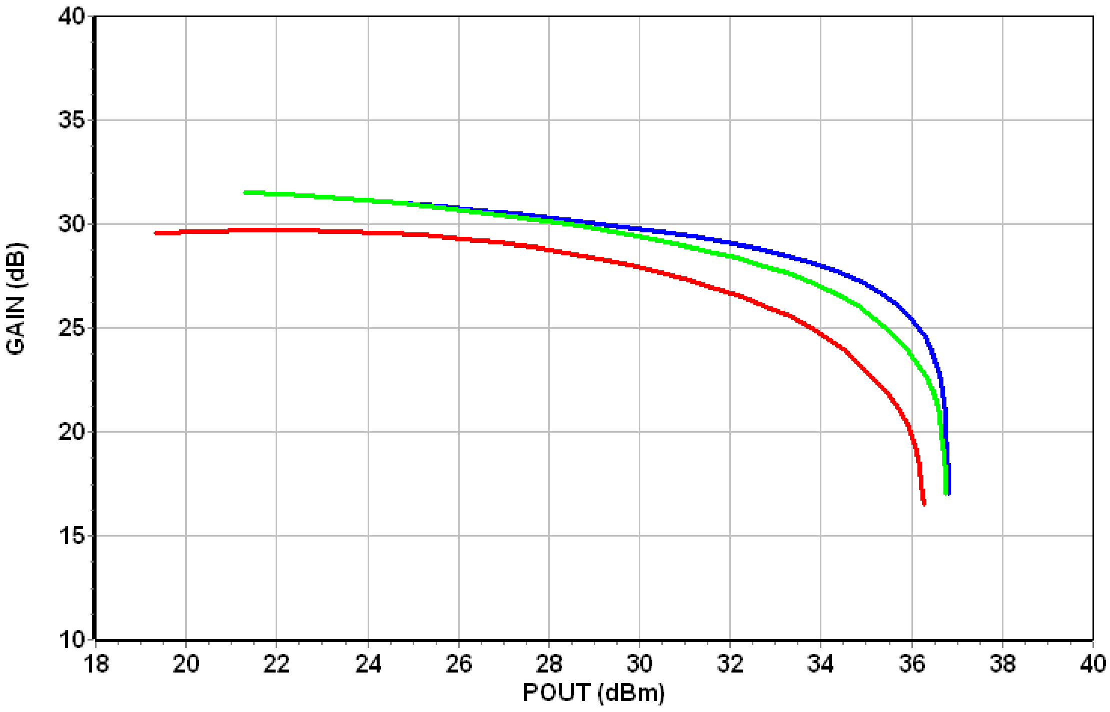
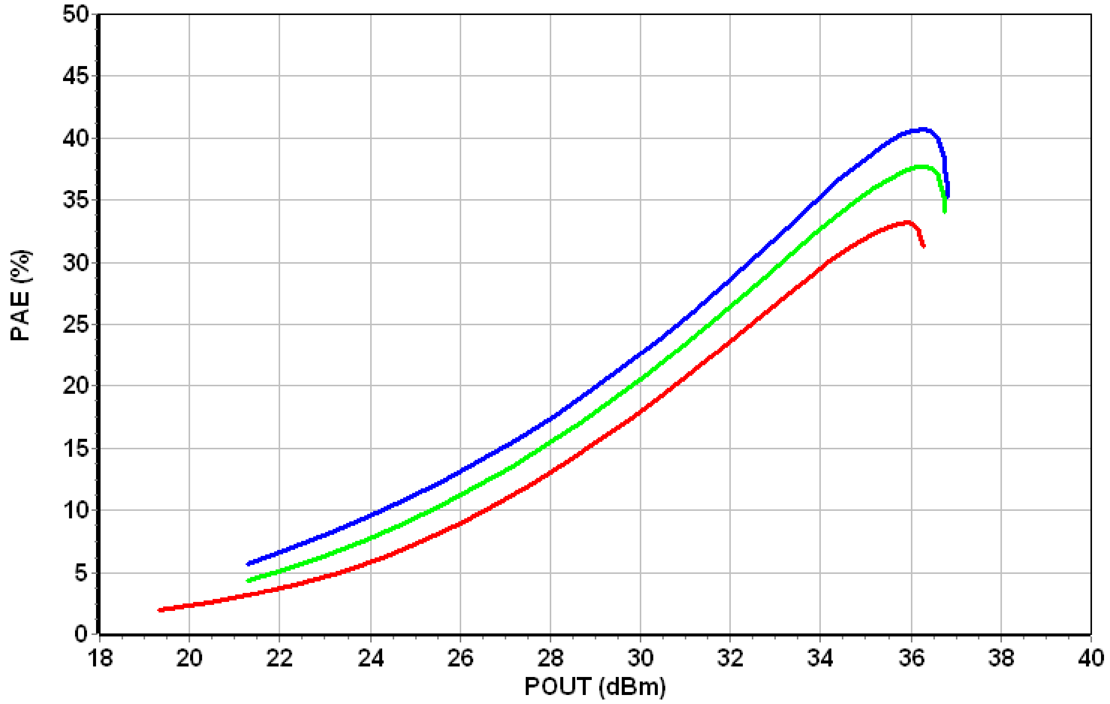
Typical Test Fixture Measurements : Non-linear performances

CW measurements:Vd = +18V, Idq = 182mA, Frequency=21GHz (Adjusted at T_{case}=25°C).

Gain versus Output Power & Temperature



Power Added Efficiency versus Output Power & Temperature



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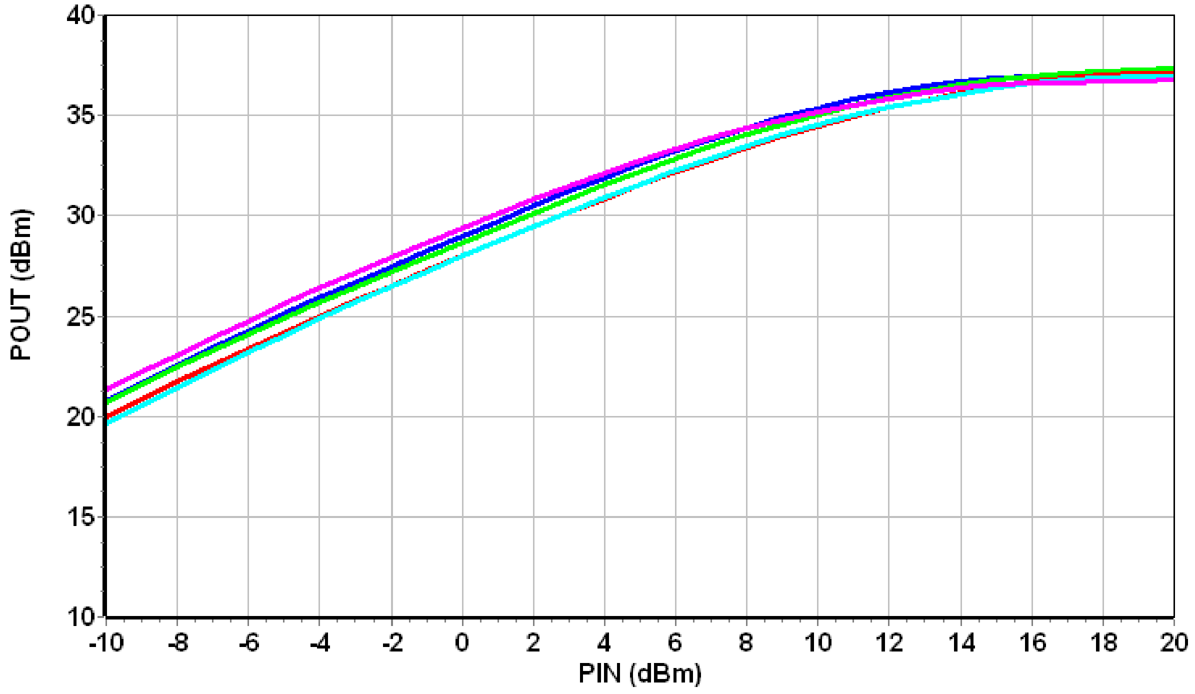
Typical Test Fixture Measurements : Non-linear performances

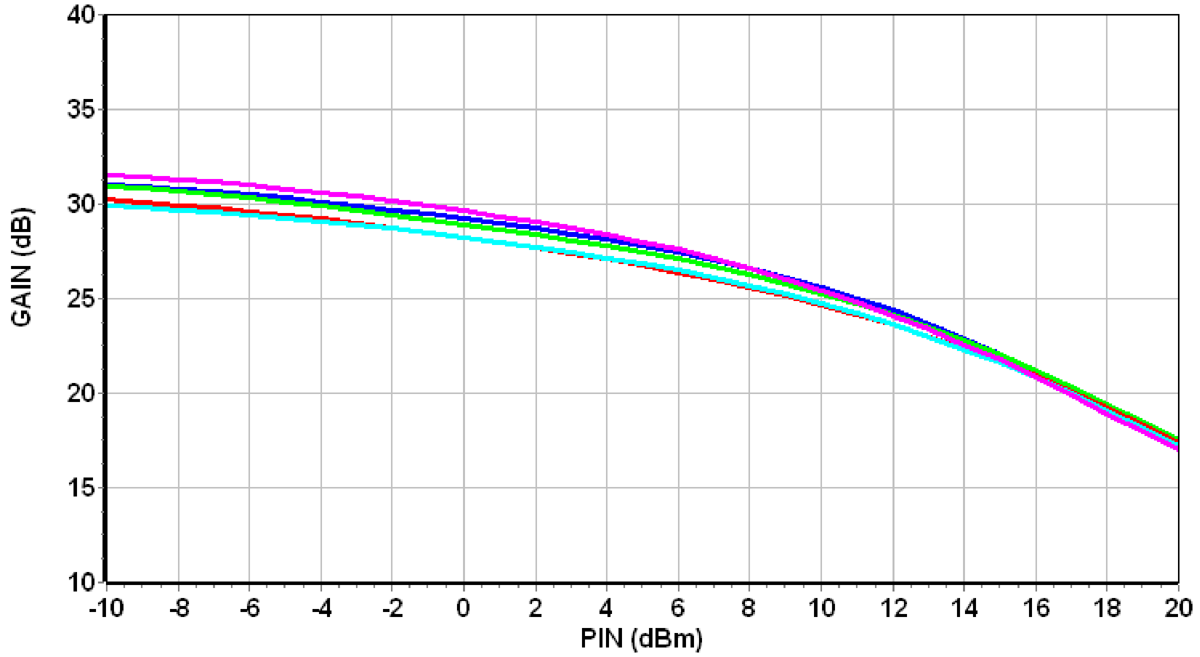
CW measurements: T_{case}=+25°C, Vd = +18V, Idq = 182mA (Adjusted at T_{case}=25°C).

Output Power versus Input Power & Frequency



— Freq=17GHz — Freq=18GHz — Freq=19GHz — Freq=20GHz — Freq=21GHz

Gain versus Input Power & Frequency



— Freq=17GHz — Freq=18GHz — Freq=19GHz — Freq=20GHz — Freq=21GHz

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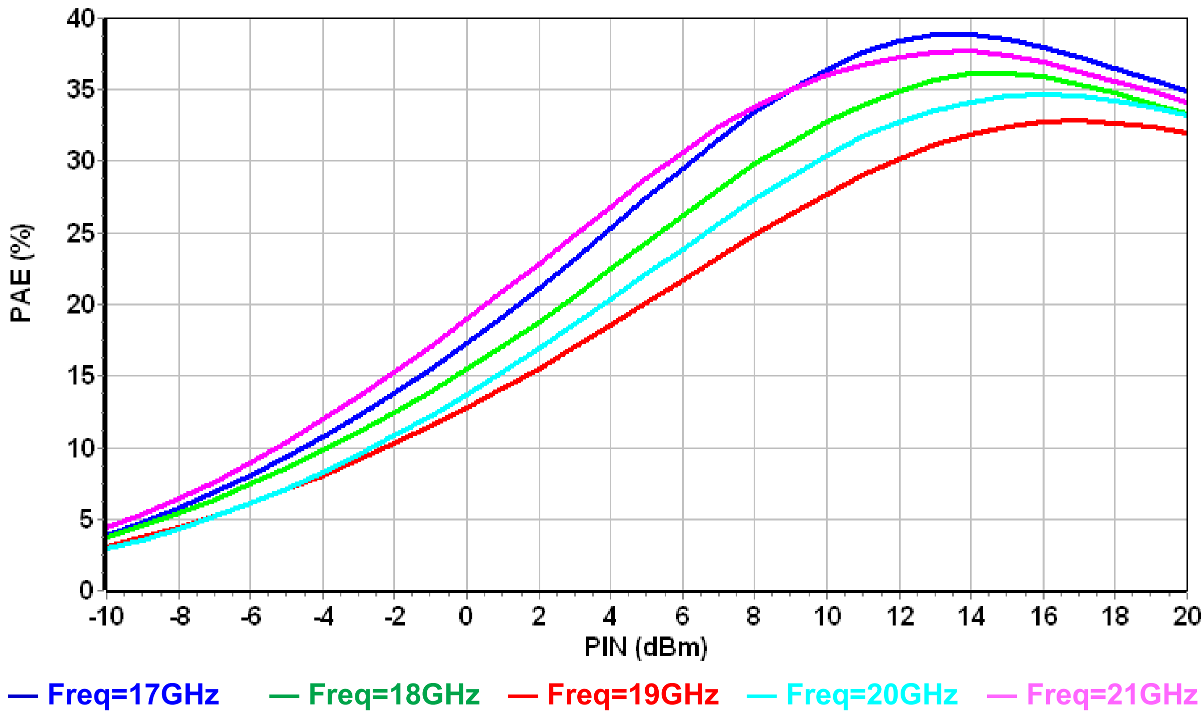
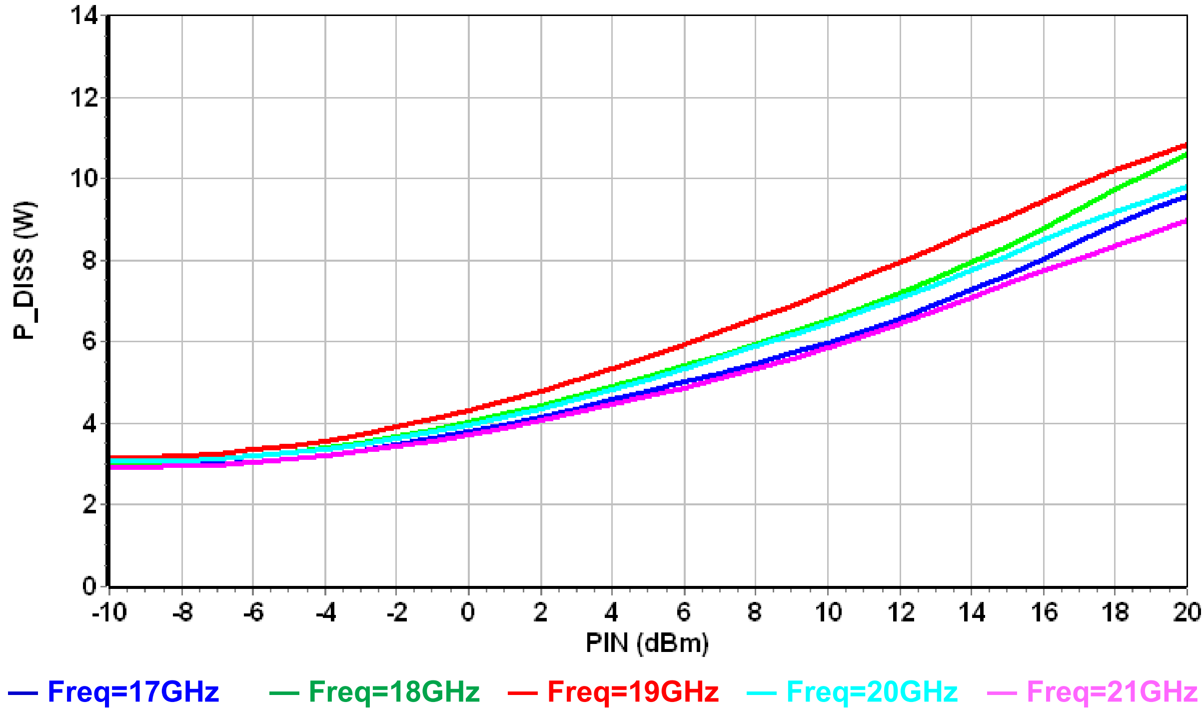
Typical Test Fixture Measurements : Non-linear performances

CW measurements: T_{case}=+25°C, Vd = +18V, Idq = 182mA (Adjusted at T_{case}=25°C).

Power Added Efficiency versus Input Power & Frequency



Dissipated Power versus Input Power & Frequency



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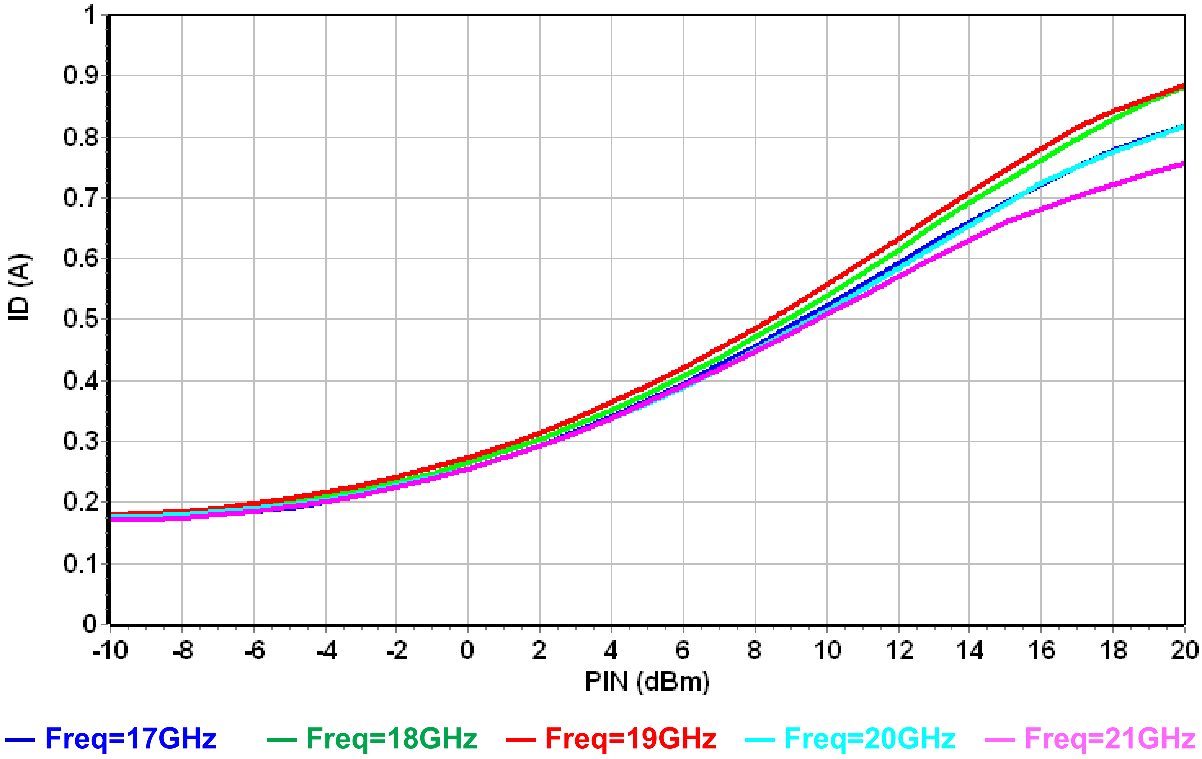
Typical Test Fixture Measurements : Non-linear performances

CW measurements: T_{case}=+25°C, Vd = +18V, Idq = 182mA (Adjusted at T_{case}=25°C).

Drain Current versus Input Power & Frequency



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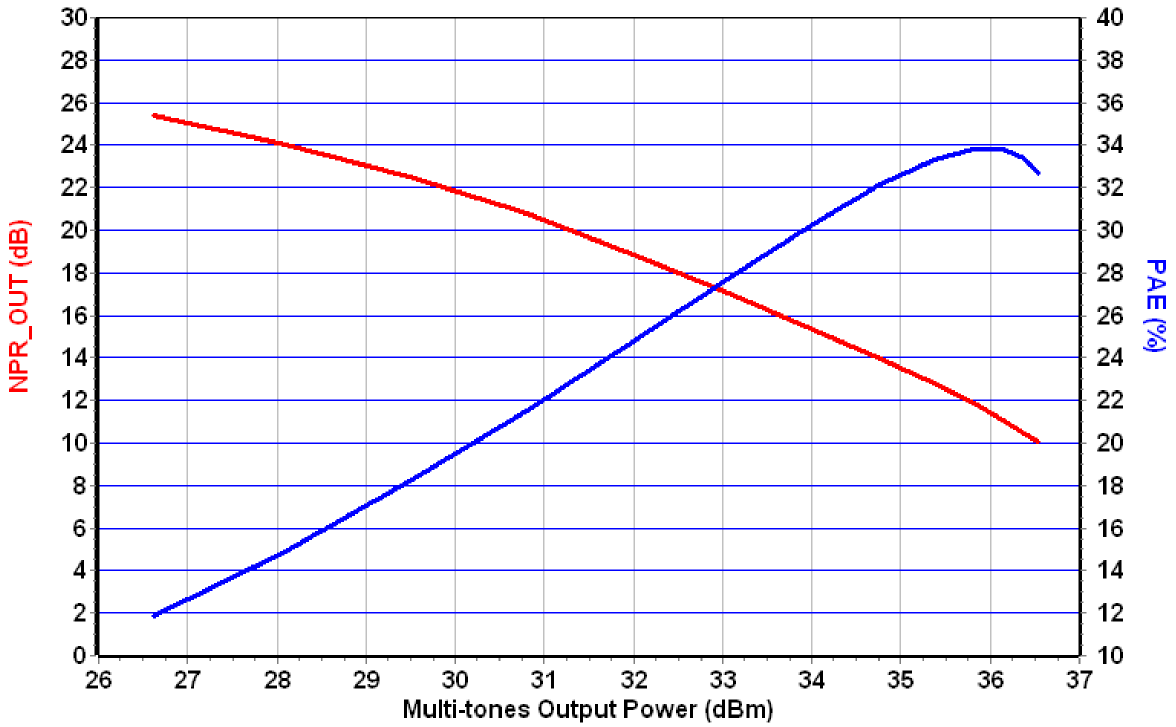
Typical Test Fixture Measurements : NPR performances

T_{case}=+25°C, Vd = +18V, Idq = 182mA

Center Frequency : 19.3GHz

Measured bandwidth : 45MHz

Notch width : 2MHz



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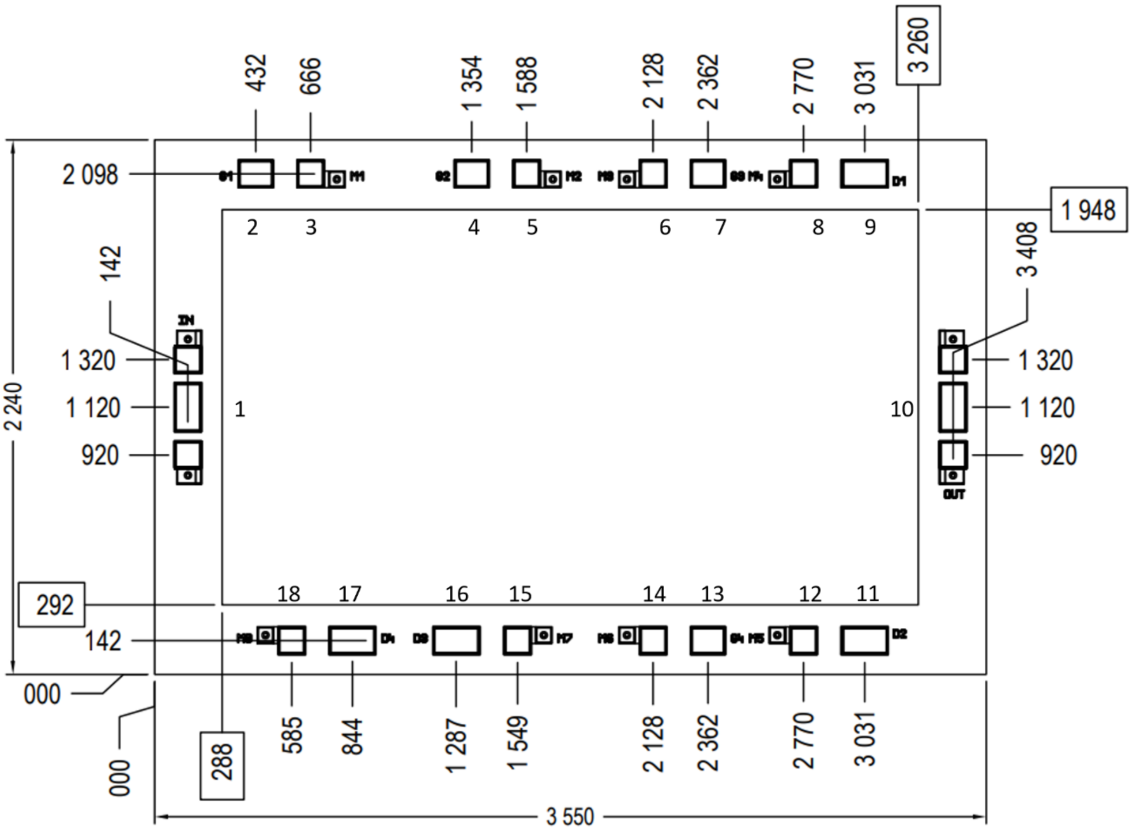
Chip Mechanical data



All dimensions are in micrometres.
Chip size = 3550x2240 ±50µm
Chip thickness = 70µm ±10µm

Chip width and length are given with a tolerance of ±50µm
RF pads (1, 10) = 208 x 118µm²

DC pads (3, 5, 6, 8, 12, 14, 15, 18) = 118 x 118µm²
DC pads (2, 4, 7, 13) = 150 x 118µm²
DC pads (9, 11, 16) = 203 x 118µm²
DC pads (17) = 200 x 118µm²

PAD Number	Name	Description
1	IN	RF input
3, 5, 6, 8, 12, 14, 15, 18	GND	Ground (Not connected)
2	VG1	Gate voltage of 1st stage
4	VG2	Gate voltage of 2nd stage
7, 13	VG3	Gate voltage of 3rd stage
17	VD1	Drain voltage of 1st stage
16	VD2	Drain voltage of 2nd stage
9, 11	VD3	Drain voltage of 3rd stage
10	OUT	RF output

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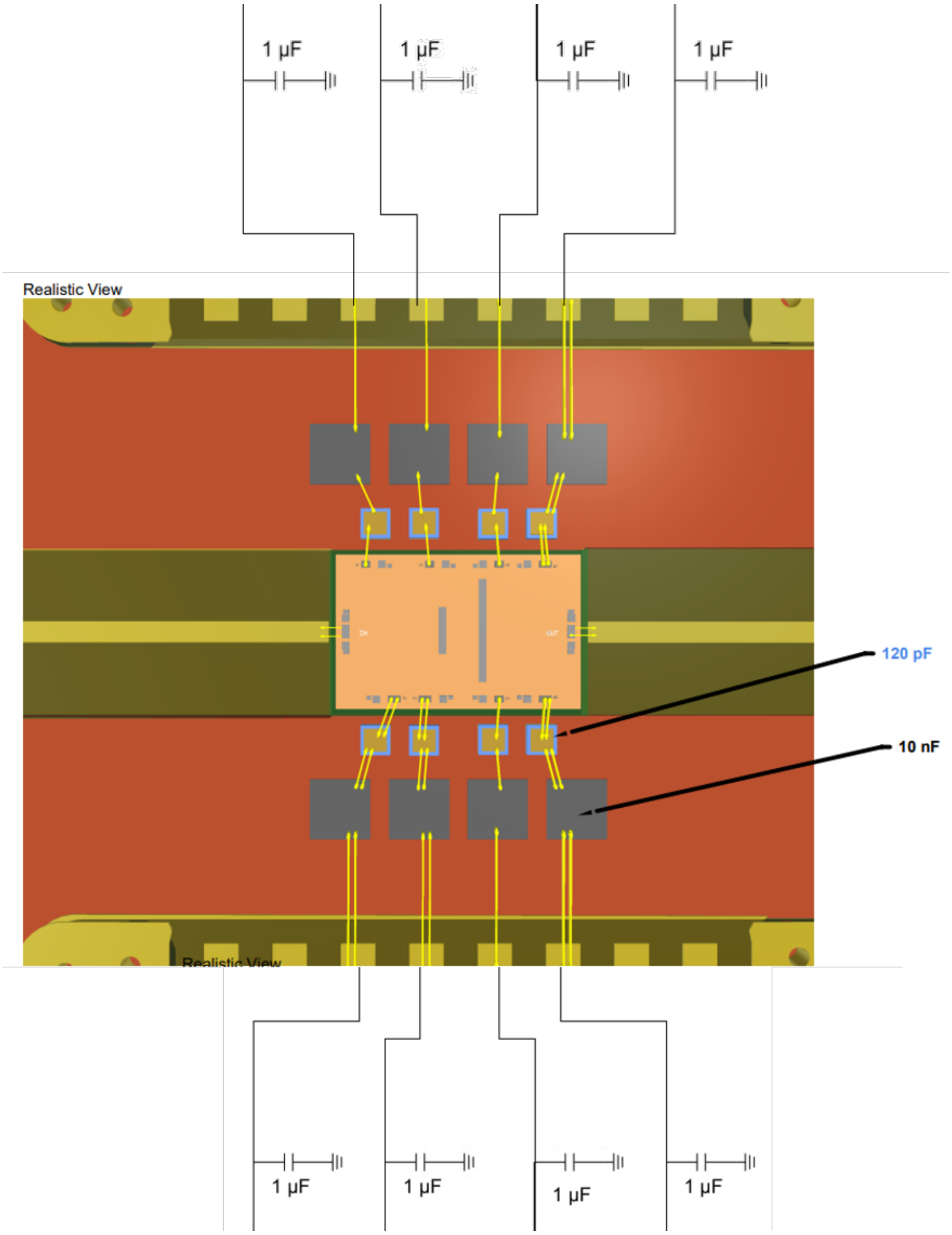
Recommended assembly plan



3 levels of decoupling capacitor have been used:

- First level of capacitor is 120pF
- Second level is 10nF
- Third level is 1µF on SMB connectors

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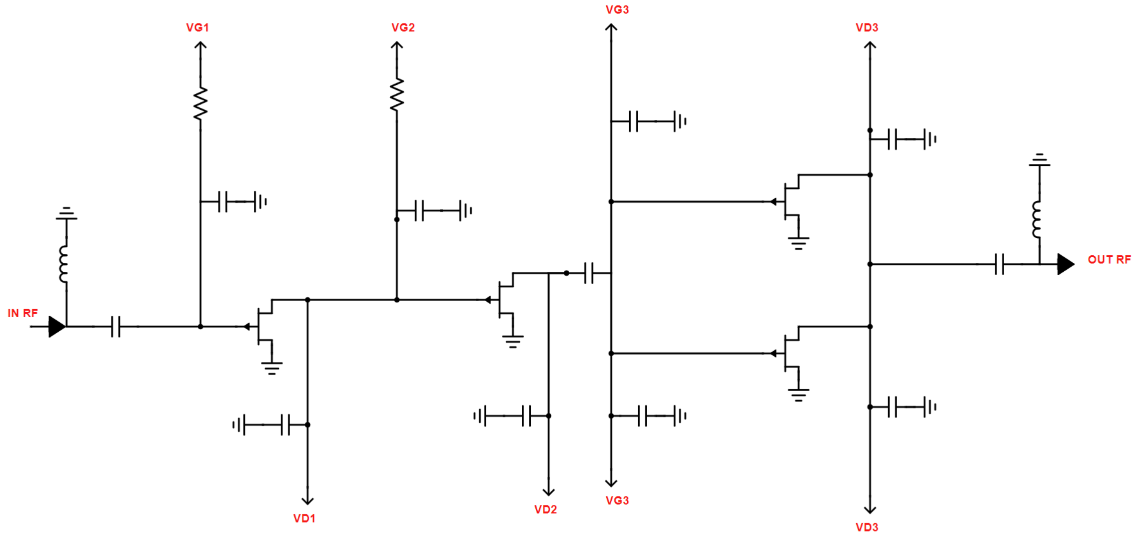
DC Schematic

Due to ESD protection circuits on RF input and output, an external capacitance might be requested to isolate the product from external voltage that could be present on the RF accesses.



The DC connections do not include any decoupling capacitor in package, therefore it is mandatory to provide a good external DC decoupling (120pF, 10nF, 1µF) on the PC board, as close as possible to the die.

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Notes:

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Recommended environmental management

UMS products are compliant with the regulation in particular with the directives RoHS N°2011/65 and REACh N°1907/2006. More environmental data are available in the application note AN0019 also available at https://www.ums-rf.com.

Recommended ESD management

Refer to the application note AN0020 available at https://www.ums-rf.com for ESD sensitivity and handling recommendations for the UMS package products.

Ordering Information

CHA6262-99F/XY

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