United Monolithic Semiconductors

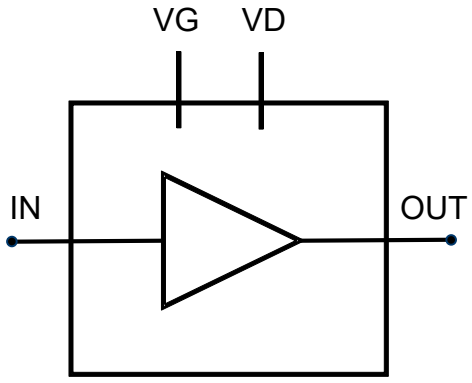
CHA5005-99F

0.9-1.8GHz Medium Power Amplifier

GaAs Monolithic Microwave IC

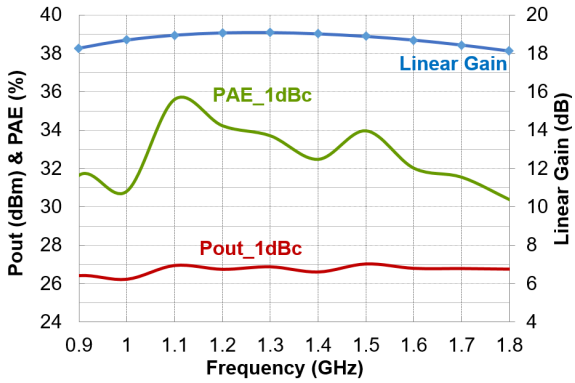
Description

The CHA5005-99F is a monolithic one-stage driver amplifier that produces 26.5dBm output power associated to 33% power added efficiency at 1dB gain compression.
It is designed for a wide range of applications, from military to commercial communication systems.
The circuit is manufactured with a pHEMT process, 0.25µm gate length, via holes through the substrate, air bridges and electron beam gate lithography.
It is supplied as bare die.



Main Features

- Broadband performances: 0.9-1.8GHz
- 26.5dBm Pout @ 1dB gain compression
- 33% PAE @ 1dB gain compression
- 18.5dB Linear Gain
- DC bias: Vd=7.5Volt@Id=120mA



Main Electrical Characteristics

Tb = +25°C

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	0.9		1.8	GHz
Gain	Linear Gain		18.5		dB
P_{-1dB}	Output Power @1dB comp.		26.5		dBm
PAE_P_{-1dB}	Power Added Efficiency @1dB comp.		33		%

United Monolithic Semiconductors S.A.S.
Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

Specifications

Tb = +25°C, Vd = +7.5V, Id = 120mA. CW mode.

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	0.9		1.8	GHz
Gain	Linear Gain		18.5		dB
RL_in	Input Return Loss		12		dB
RL_out	Output Return Loss		12		dB
P_{-1dB}	Output Power @1dB comp.		26.5		dBm
PAE_P_{-1dB}	Power Added Efficiency @1dB comp.		33		%
Id_P_{-1dB}	Supply drain current @1dB comp.		190		mA
P_{-3dB}	Output Power @3dB comp.		28		dBm
PAE_P_{-3dB}	Power Added Efficiency @3dB comp.		38		%
Id_P_{-3dB}	Supply drain current @3dB comp.		220		mA
Vd	Drain bias voltage		7.5		V
Id	Quiescent bias drain current		120		mA
Vg	Gate bias voltage		-0.45		V

These values are representative of onboard measurements as defined on the drawing in paragraph "Evaluation mother board".

Absolute Maximum Ratings (1)

Tb = +25°C

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	9.5	V
Id_max	Drain current @ maximum input power	270	mA
Pin	Maximum input power	17	dBm
Vg	Gate bias voltage	-3 to -0.3	V

(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	8	V
Idq	Drain bias quiescent current	200	mA
Pin	Maximum input power	15	dBm
Vg	Gate bias voltage	-2.5 to -0.35	V
Tj	Maximum Junction temperature (4)	175	°C

(2) Electrical performances are defined for specified test conditions.

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

(4) See “Device thermal performances” paragraph.

Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

Temperature Range

Tcase	Operating temperature range	-40 to +85	°C
Tstg	Storage temperature range	-55 to +150	°C

Typical Bias Conditions

Tb = +25°C

Symbol	Pad N°	Parameter	Values	Unit
Vd	22	Drain bias voltage	7.5	V
Vg	24	Gate bias voltage	-0.45	V

“Power ON” sequence

1. Bias MPA gate voltage at Vg close to Vpinch-off (Typically: Vg ≈ -1.5V)
2. Apply Vd bias voltage (Typically: Vd = 7.5V)
3. Increase Vg up to quiescent bias drain current Id
4. Apply RF signal

“Power OFF” sequence

1. Turn off RF signal
2. Bias MPA gate voltage at Vg close to Vpinch-off (Typically: Vg ≈ -1.5V)
3. Turn Vd bias voltage to 0V
4. Turn Vg bias voltage to 0V

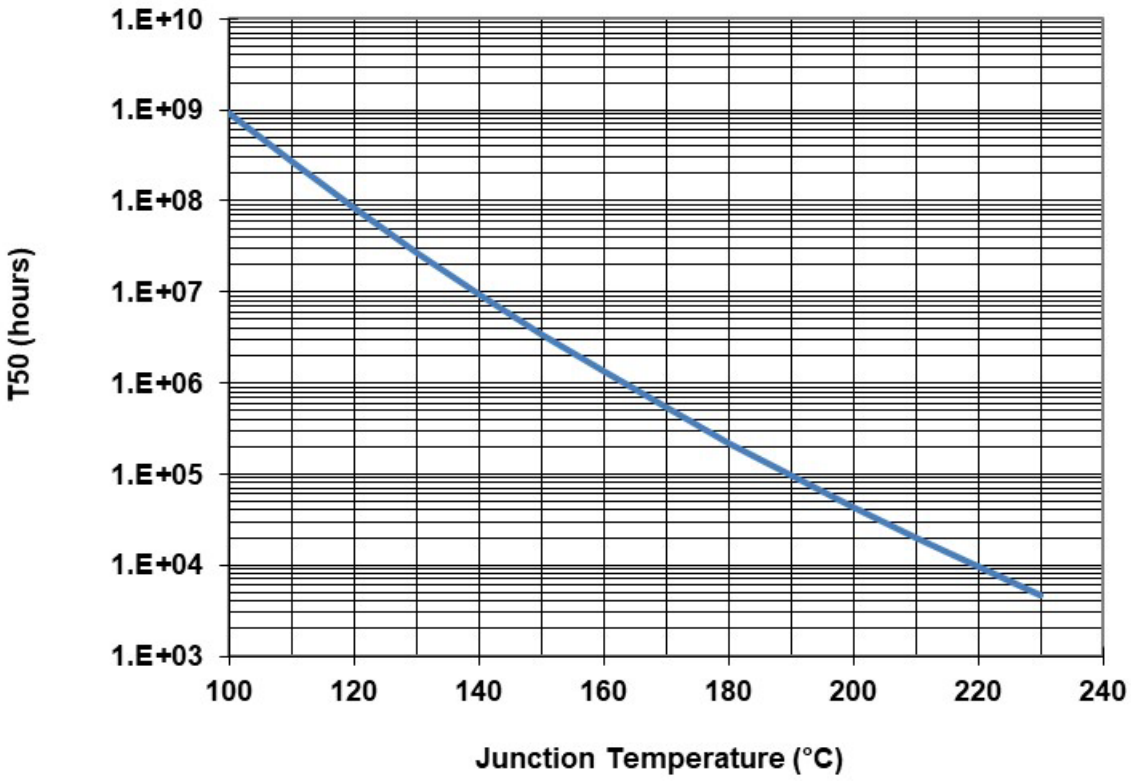
Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

Device thermal performance

All the figures given in this section are obtained assuming that the bare die is only cooled down by conduction (no convection mode considered).
The temperature is monitored at the die back-side interface (Tb).
The system maximum temperature must be adjusted in order to guarantee that Tjunction remains below the maximum value specified in the Absolute Maximum Ratings table.
So, the system PCB must be designed to comply with this requirement.

Parameter	Biasing conditions	Tjunction (°C)	R_{TH} (°C/W)	T50 (hours)
R_{TH} (1) Thermal Resistance (Junction to Chip back side)	Vd= 7.5V Id= 120mA, Id_drive=210mA Pdiss= 1W in CW Mode	155	65.4	2E+06

(1) Assuming Tb=85°C



Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

Typical bare die (without wire bondings) Sij parameters

Tb = +25°C, Vd = +7.5V, Idq = 120mA (from on wafer measurements)

Freq (GHz)	S11 (dB)	PhS11 (°)	S12 (dB)	PhS12 (°)	S21 (dB)	PhS21 (°)	S22 (dB)	PhS22 (°)
0.3	-1.83	-54.88	-31.18	-129.21	-2.26	-79.27	-2.26	-74.20
0.4	-3.21	-76.28	-31.44	167.15	3.70	-54.45	-3.63	-104.39
0.5	-4.96	-97.35	-30.14	110.35	9.61	-67.31	-4.96	-128.92
0.6	-10.63	-124.26	-31.56	92.86	14.97	-90.89	-7.93	-156.42
0.7	-15.40	-106.60	-28.68	68.68	16.93	-122.54	-10.25	-169.37
0.8	-16.85	-91.97	-27.68	45.86	17.84	-146.11	-12.20	172.12
0.9	-17.03	-81.00	-27.25	27.12	18.39	-165.90	-14.71	149.28
1	-16.52	-76.09	-27.01	10.59	18.70	176.96	-17.26	120.38
1.1	-15.78	-76.01	-26.85	-4.36	18.86	161.51	-19.04	82.85
1.2	-14.97	-80.06	-26.87	-17.92	18.96	147.32	-18.42	43.67
1.3	-14.19	-86.90	-26.91	-30.11	18.96	134.18	-16.53	14.81
1.4	-13.45	-95.78	-27.02	-41.60	18.91	121.63	-14.46	-6.12
1.5	-12.77	-106.30	-27.19	-52.97	18.81	109.53	-12.67	-21.73
1.6	-12.08	-117.73	-27.39	-63.37	18.66	98.02	-11.14	-34.48
1.7	-11.37	-129.76	-27.66	-73.06	18.47	86.89	-9.86	-45.32
1.8	-10.67	-141.95	-28.01	-82.68	18.24	76.05	-8.79	-55.34
1.9	-9.96	-154.28	-28.34	-92.08	17.97	65.59	-7.88	-64.52
2	-9.29	-165.96	-28.74	-101.30	17.65	55.52	-7.09	-72.91
2.1	-8.60	-177.17	-29.30	-109.70	17.30	45.72	-6.44	-80.94
2.2	-7.92	172.38	-29.79	-117.73	16.95	36.00	-5.92	-88.63
2.3	-7.31	162.28	-30.25	-125.75	16.53	26.65	-5.46	-95.72
2.4	-6.73	152.91	-30.71	-132.41	16.11	17.87	-5.05	-102.27
2.5	-6.21	144.19	-31.25	-140.16	15.68	9.26	-4.73	-108.70
2.6	-5.73	136.09	-31.82	-146.56	15.24	0.87	-4.48	-114.76
2.7	-5.29	128.59	-32.27	-153.16	14.78	-7.28	-4.26	-120.64
2.8	-4.90	121.48	-32.66	-158.74	14.35	-15.22	-4.10	-126.35
2.9	-4.55	114.84	-33.52	-164.34	13.88	-22.95	-3.97	-131.59
3	-4.22	108.65	-33.97	-171.40	13.45	-30.66	-3.88	-136.64
3.1	-3.93	102.96	-34.50	-174.07	13.00	-37.92	-3.83	-141.38
3.2	-3.67	97.53	-35.03	179.03	12.57	-45.28	-3.79	-145.90
3.3	-3.44	92.30	-35.55	173.74	12.15	-52.53	-3.78	-150.20
3.4	-3.23	87.58	-36.01	170.57	11.72	-59.76	-3.78	-154.30
3.5	-3.04	83.12	-36.46	164.87	11.30	-66.89	-3.79	-158.15
3.6	-2.88	78.75	-37.03	159.92	10.89	-74.10	-3.83	-161.71
3.7	-2.71	74.72	-37.26	154.68	10.47	-81.24	-3.87	-165.10
3.8	-2.58	70.86	-37.69	149.99	10.05	-88.45	-3.90	-168.20
3.9	-2.46	67.22	-38.38	145.91	9.63	-95.69	-3.93	-171.11
4	-2.35	63.67	-38.58	142.68	9.18	-103.15	-3.94	-173.89

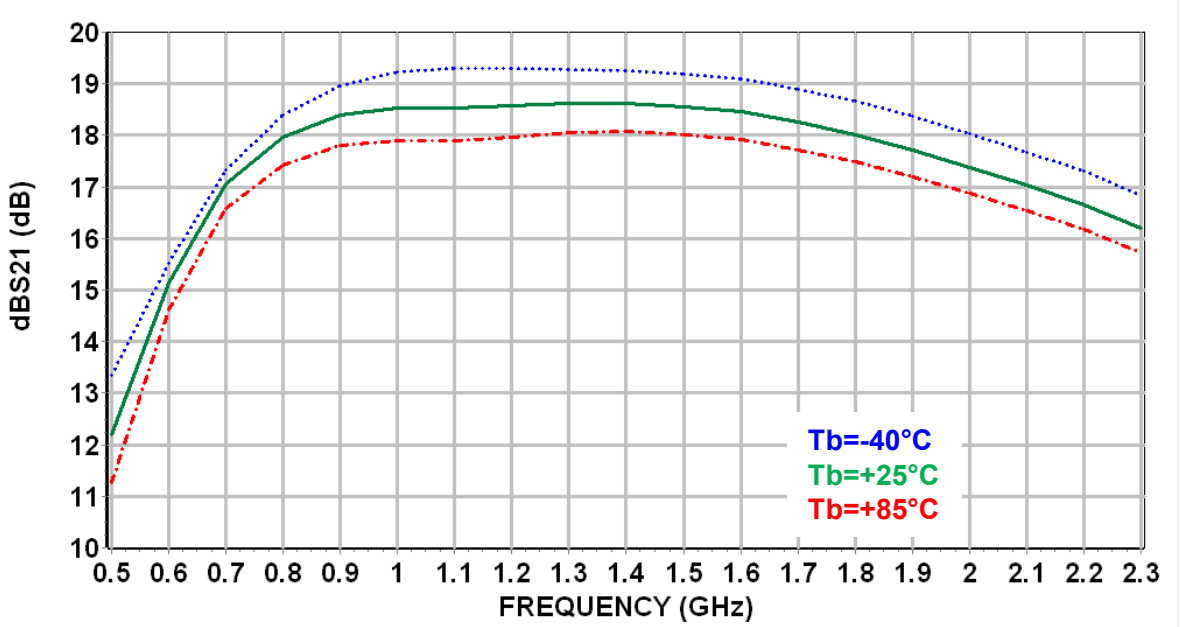
Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

Typical Board Measurements: S-parameters measurements

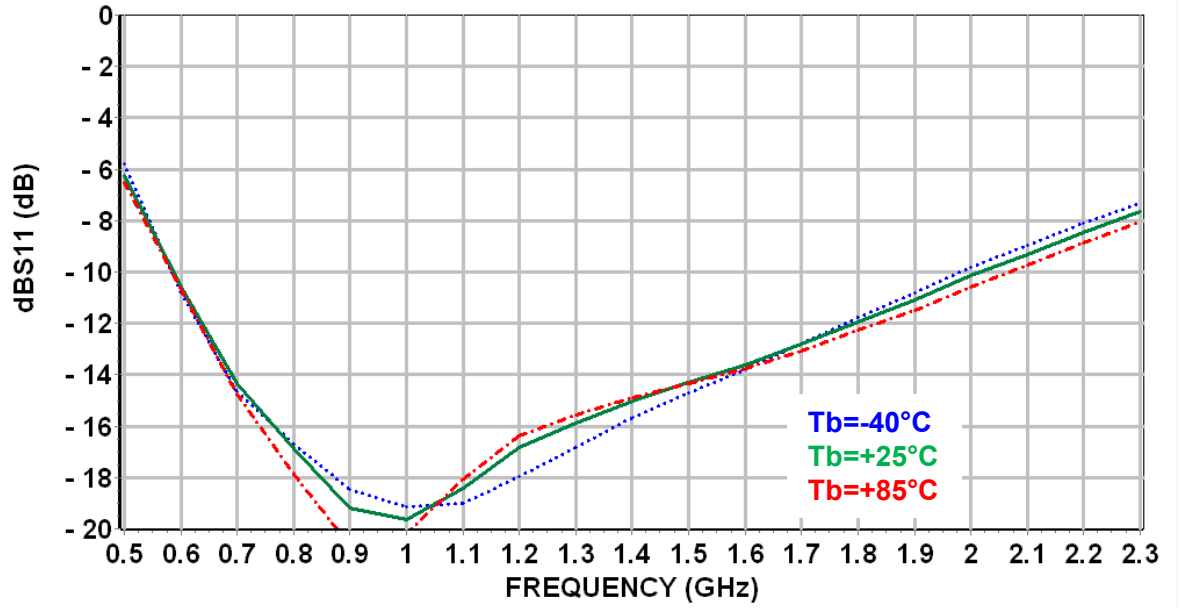
Biasing conditions: Vd = +7.5V, Idq = 120mA set at Tb=+25°C, kept constant vs temperature.
Temperature conditions Tbackside = -40°C, +25°C, +85°C

Measurements are given in the connectors' access plans, using the board given in the paragraph "Evaluation board".
CW measurements

Linear Gain versus Frequency & Temperature



Input Return Loss versus Frequency & Temperature



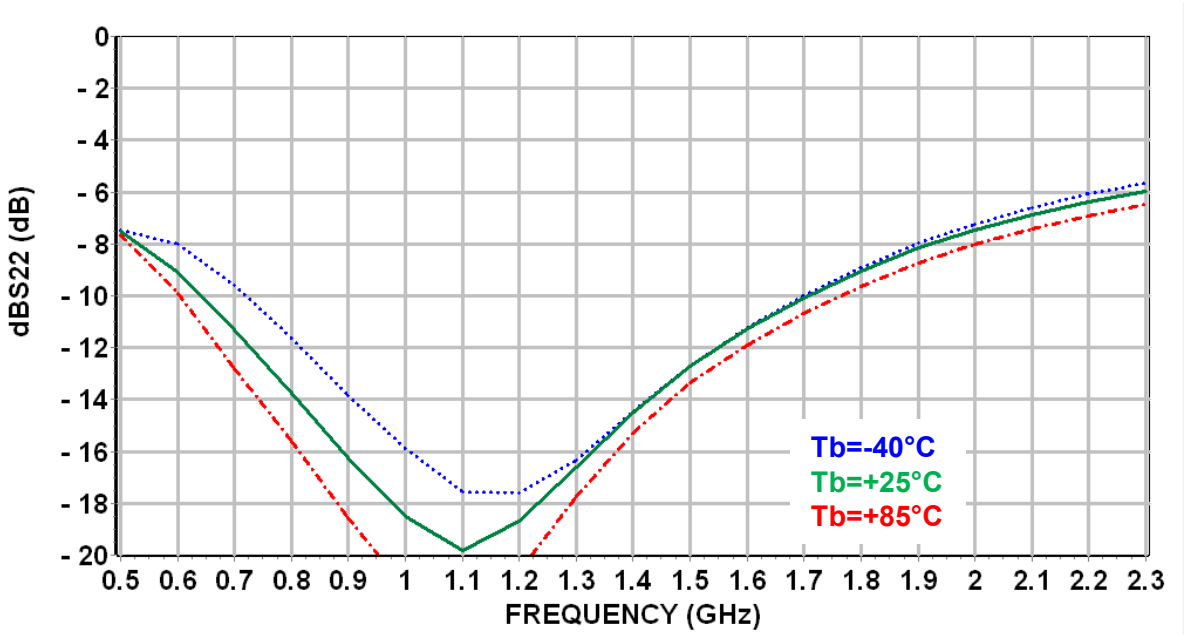
Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

Typical Board Measurements: S-parameters measurements

Biasing conditions: Vd = +7.5V, Idq = 120mA set at Tb=+25°C, kept constant vs temperature.
Temperature conditions Tbackside = -40°C, +25°C, +85°C

Measurements with temperature are given in the connectors' access plans, using the board given in the paragraph "Evaluation board".

Output Return Loss versus Frequency & Temperature

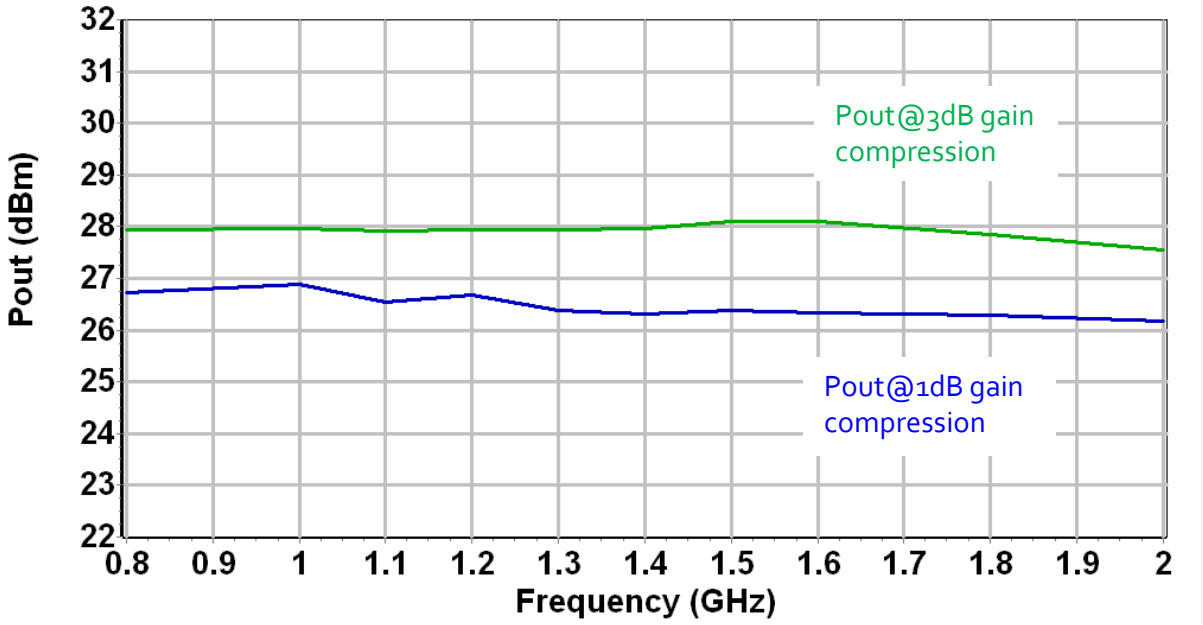


Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

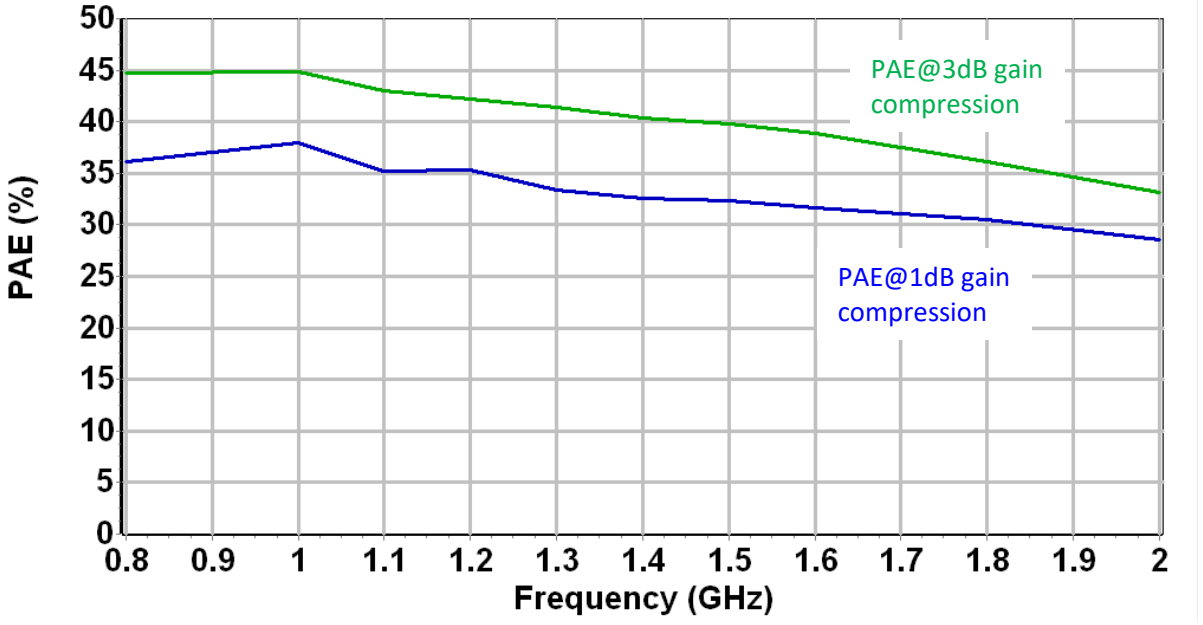
Typical Board Measurements: Power measurements

Tb = +25°C, Vd = +7.5V, Idq = 120mA
Measurements are given in the connectors' access plans, using the board given in the paragraph "Evaluation board".
CW measurements

Output Power @ 1dB & 3dB gain compression versus Frequency



Power Added Efficiency @ 1dB & 3dB gain compression versus Frequency

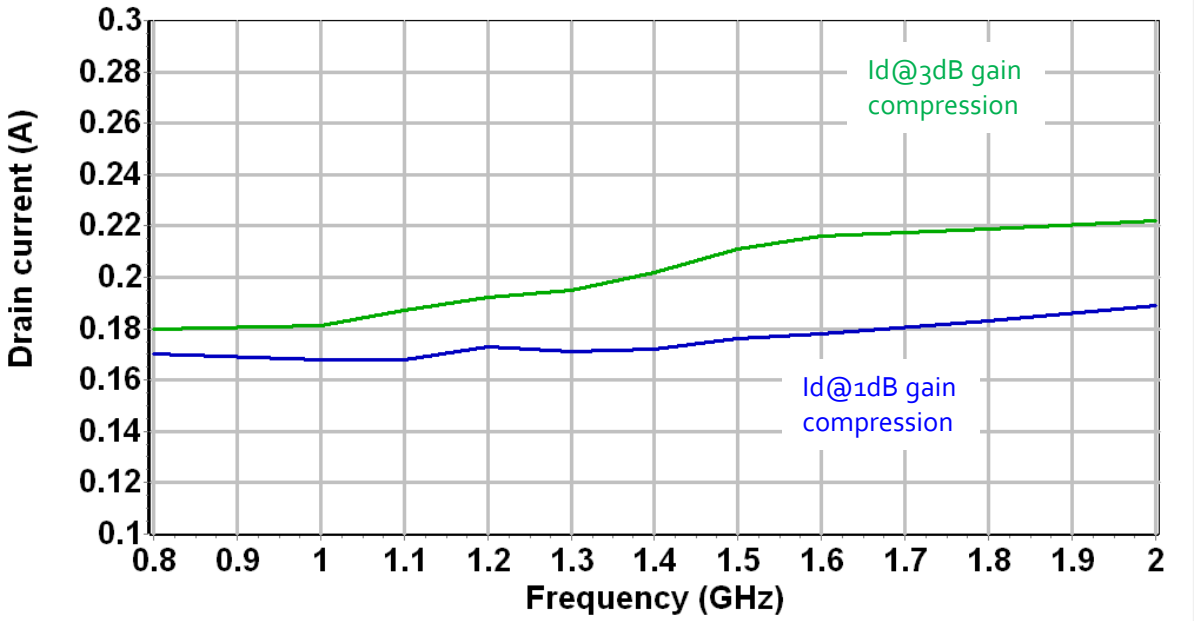


Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

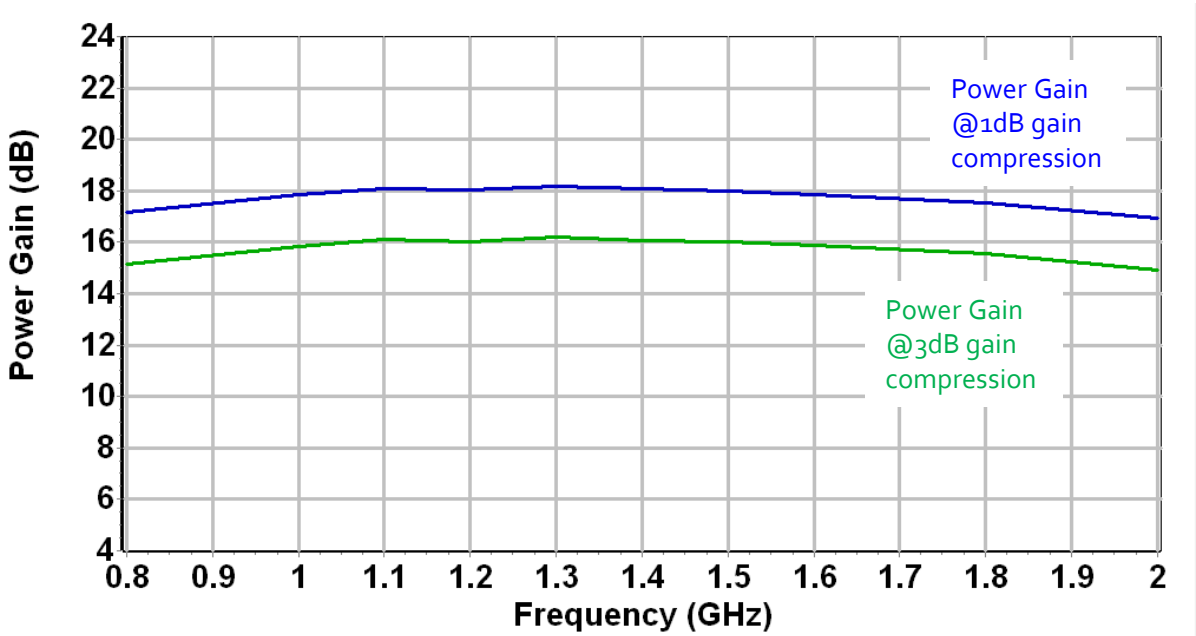
Typical Board Measurements: Power measurements

Tb = +25°C, Vd = +7.5V, Idq = 120mA
Measurements are given in the connectors' access plans, using the board given in the paragraph "Evaluation board".
CW measurements

Drain Current @ 1dB & 3dB gain compression versus Frequency



Power Gain @ 1dB & 3dB gain compression versus Frequency

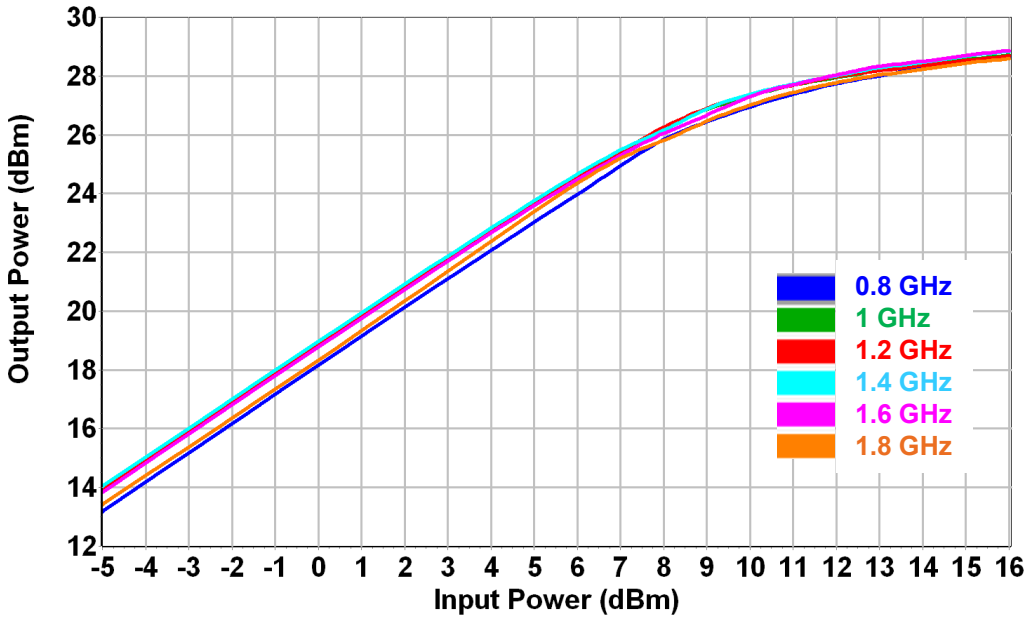


Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

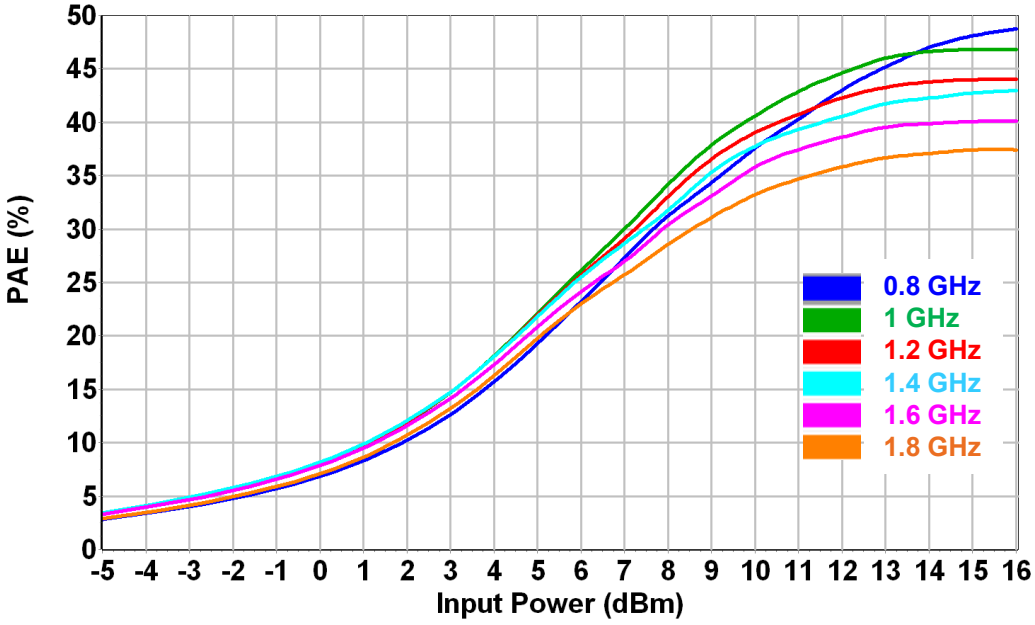
Typical Board Measurements: Power measurements

Tb = +25°C, Vd = +7.5V, Idq = 120mA
Measurements are given in the connectors' access plans, using the board given in the paragraph "Evaluation board".
CW measurements

Output Power versus Input Power and versus Frequency



Power Added Efficiency versus Input Power and versus Frequency

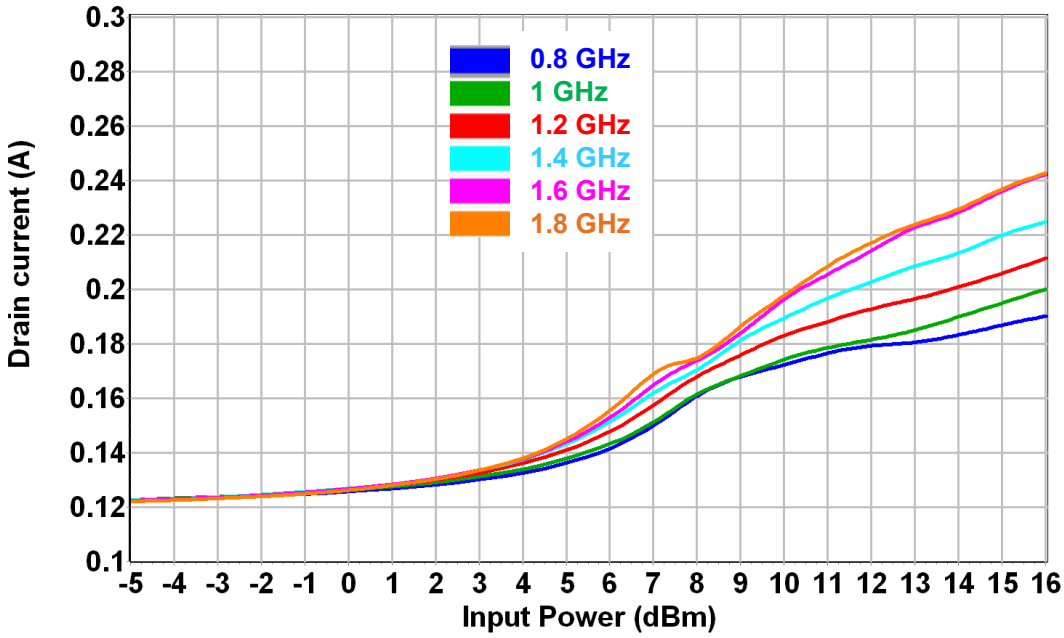


Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

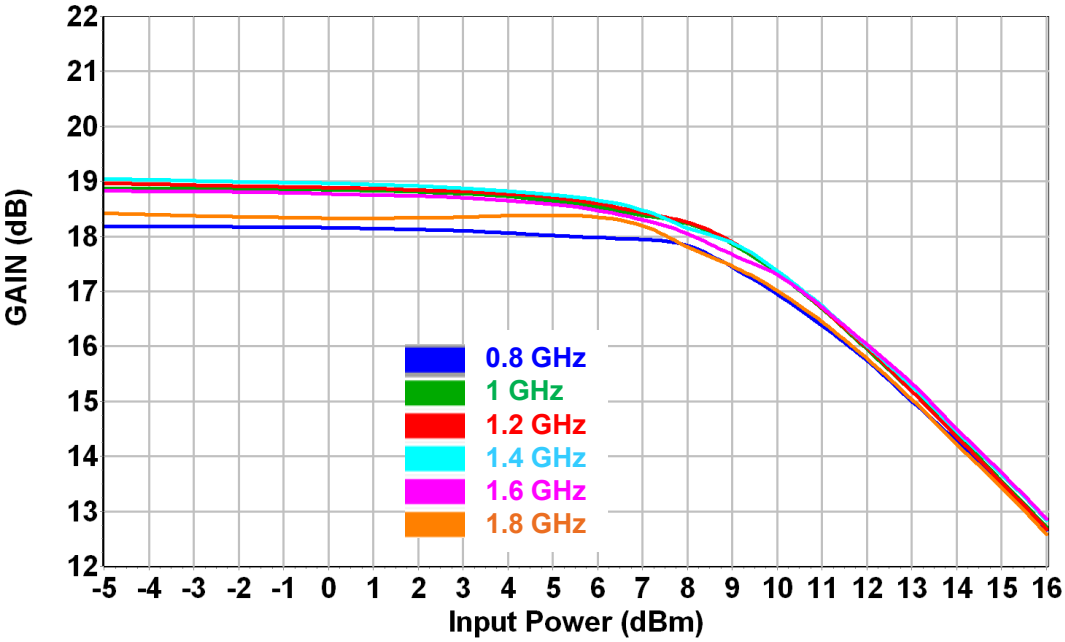
Typical Board Measurements: Power measurements

Tb = +25°C, Vd = +7.5V, Idq = 120mA
Measurements are given in the connectors' access plans, using the board given in the paragraph "Evaluation board".
CW measurements

Drain Current versus Input Power and versus Frequency



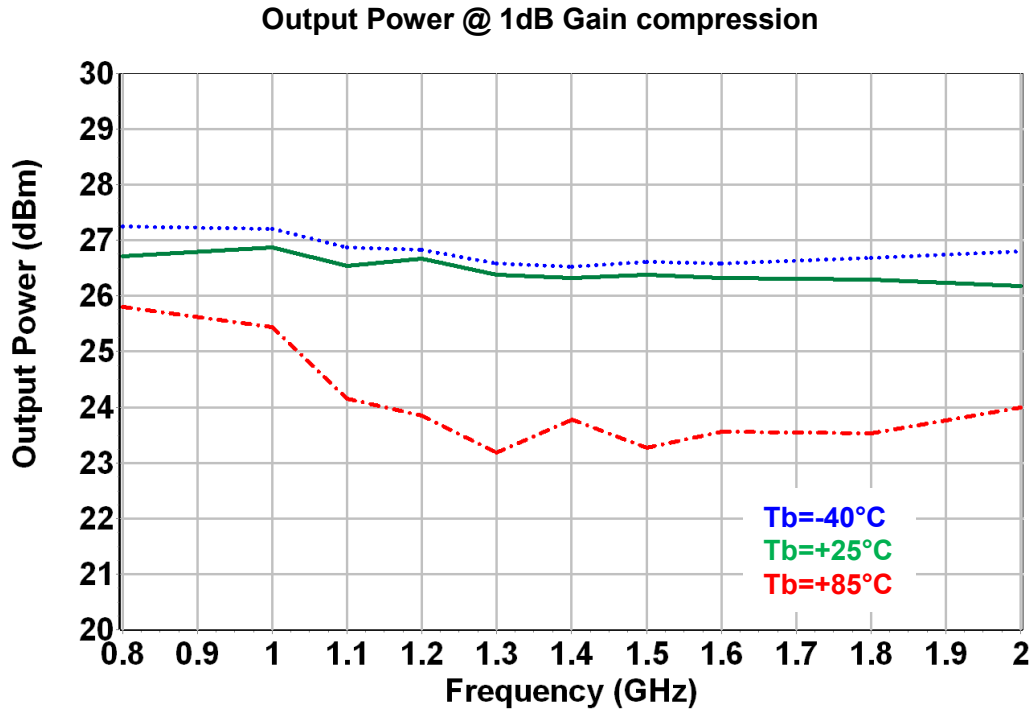
Power Gain versus Input Power and versus Frequency

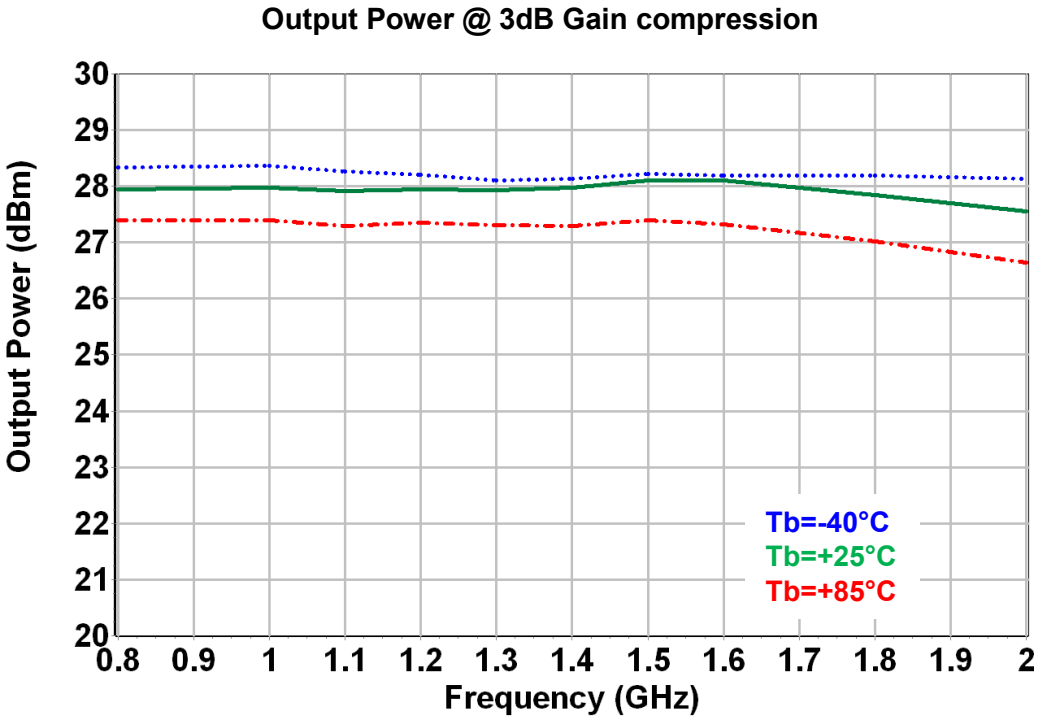


Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

Typical Board Measurements: Power measurements

Biasing conditions: Vd = +7.5V, Idq = 120mA set at Tb=+25°C, kept constant vs temperature.
Temperature conditions Tbackside = -40°C, +25°C, +85°C
CW measurements



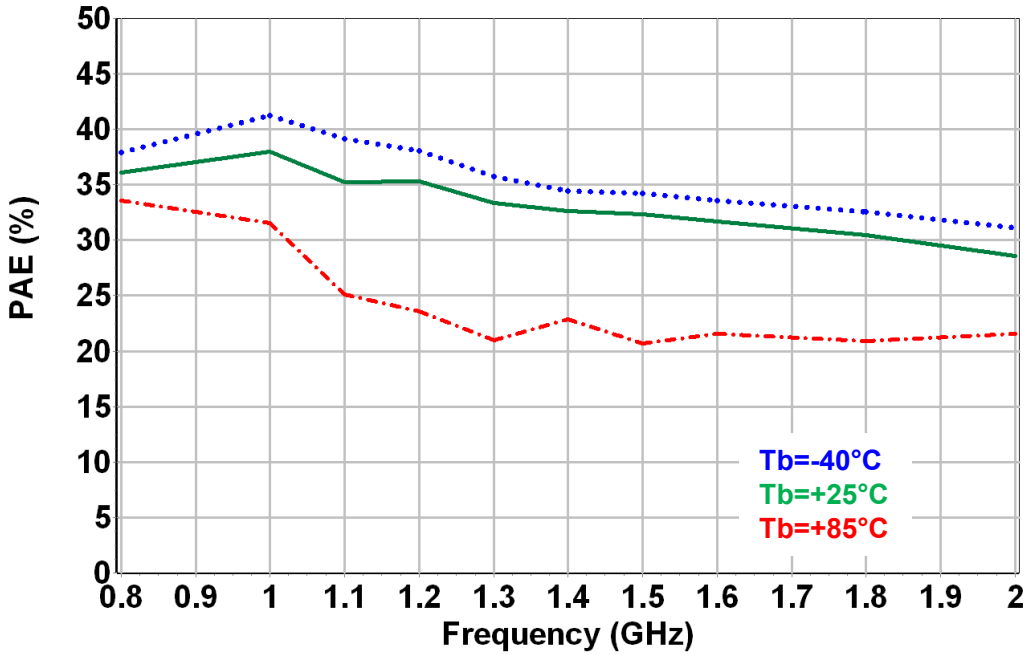


Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

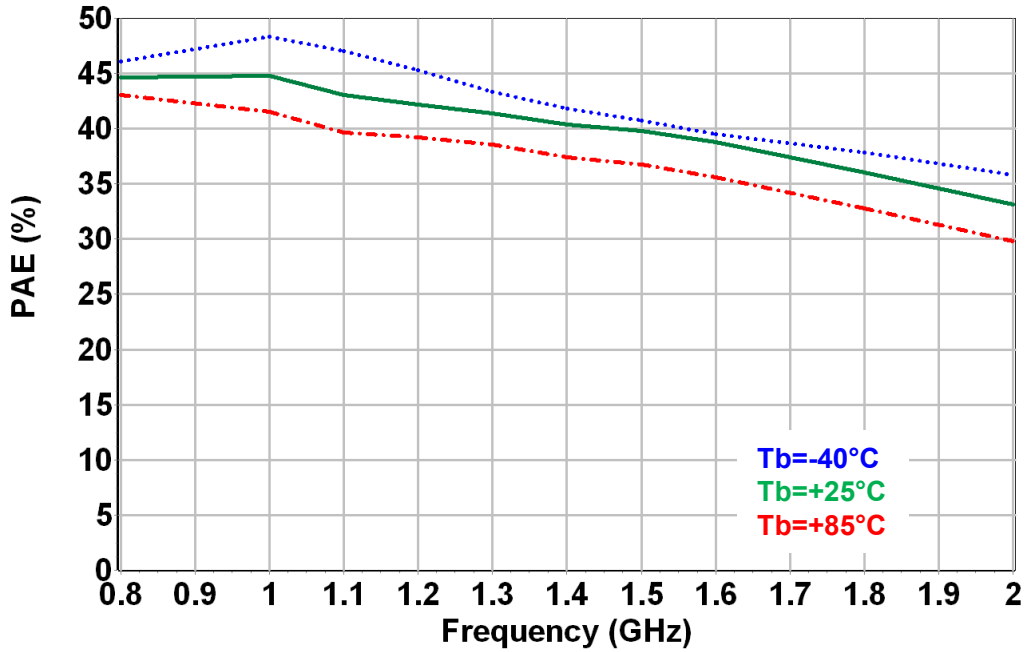
Typical Board Measurements: Power measurements

Biasing conditions: Vd = +7.5V, Idq = 120mA set at Tb=+25°C, kept constant vs temperature.
Test conditions at Tbackside = -40°C/+25°C/+85°C
Measurements are given in the connectors' access plans, using the board given in the paragraph "Evaluation board".
CW measurements

PAE @ 1dB Gain compression



PAE @ 3dB Gain compression

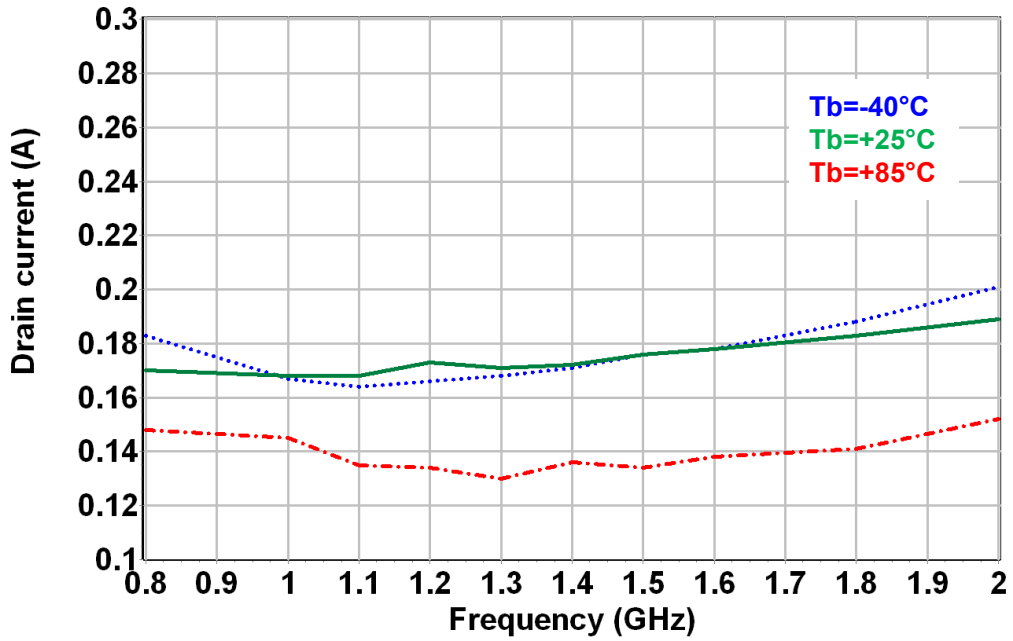


Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

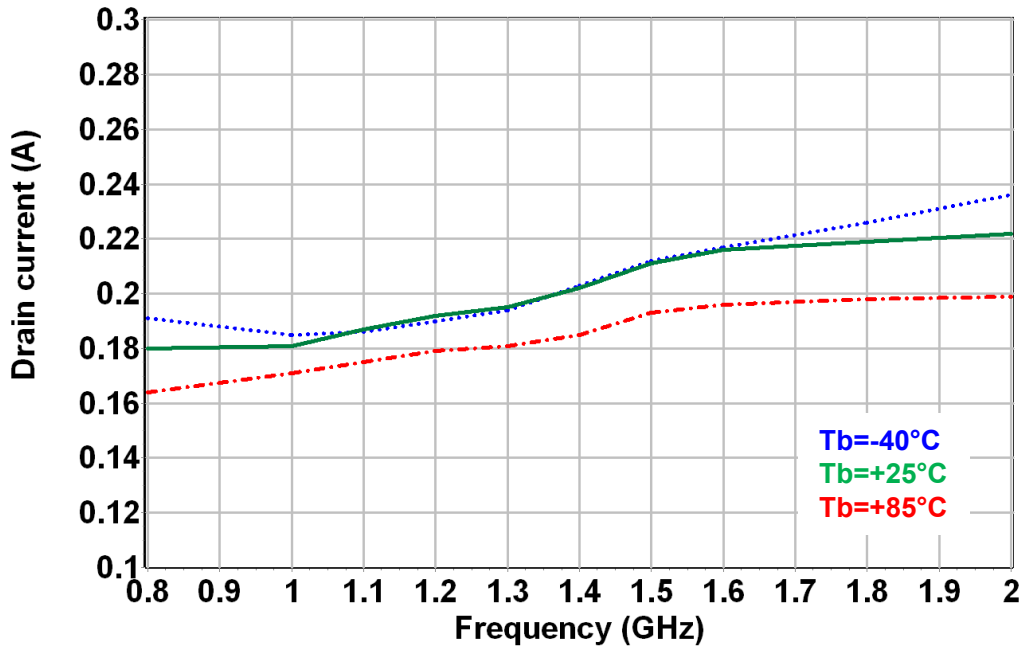
Typical Board Measurements: Power measurements

Biasing conditions: Vd = +7.5V, Idq = 120mA set at Tb=+25°C, kept constant vs temperature.
Test conditions at Tbackside = -40°C/+25°C/+85°C
Measurements are given in the connectors' access plans, using the board given in the paragraph "Evaluation board".
CW measurements

Drain current @ 1dB Gain compression vs Freq and Temp



Drain current @ 3dB Gain compression vs Freq and Temp

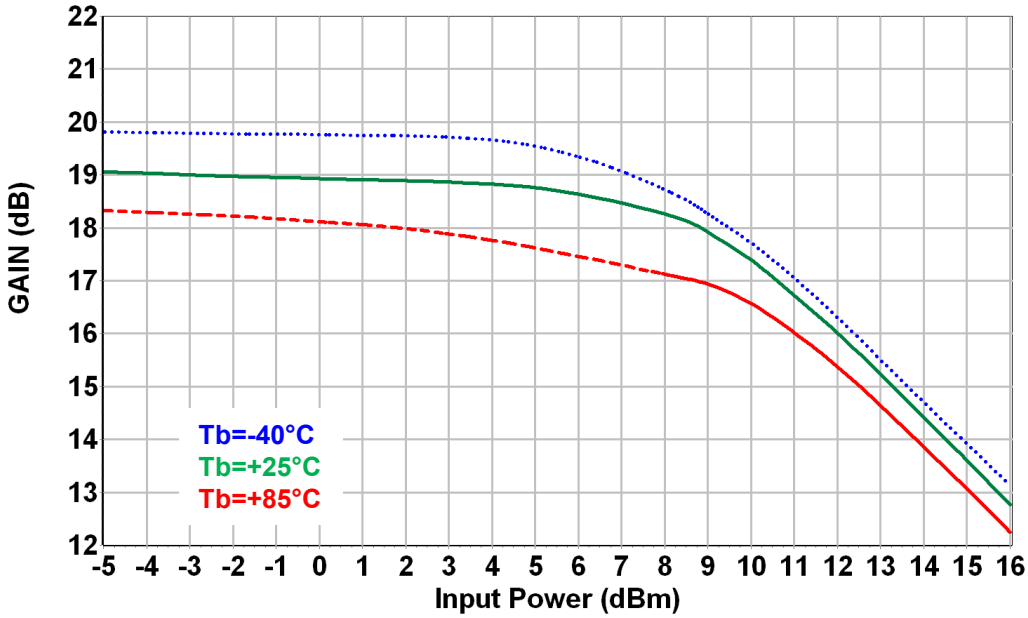


Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

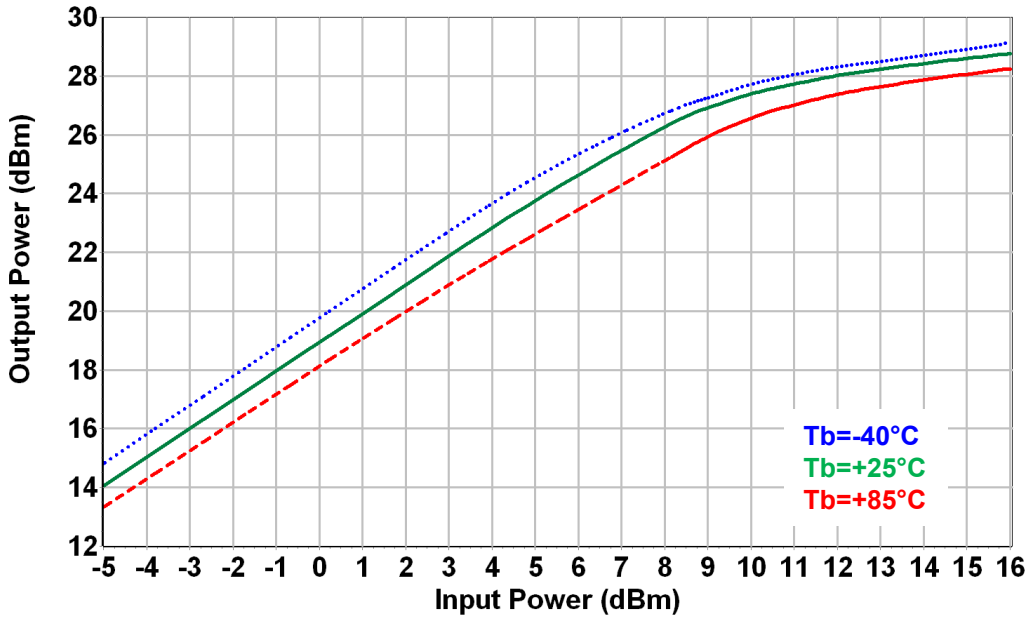
Typical Board Measurements: Power measurements

Biasing conditions: Vd = +7.5V, Idq = 120mA set at Tb=+25°C, kept constant vs temperature.
Test conditions at Tbackside = -40°C/+25°C/+85°C
Frequency : 1.3 GHz in CW measurements
Measurements are given in the connectors' access plans, using the board given in the paragraph "Evaluation board".

Power Gain versus input power and Temp



Output Power versus input power and Temp

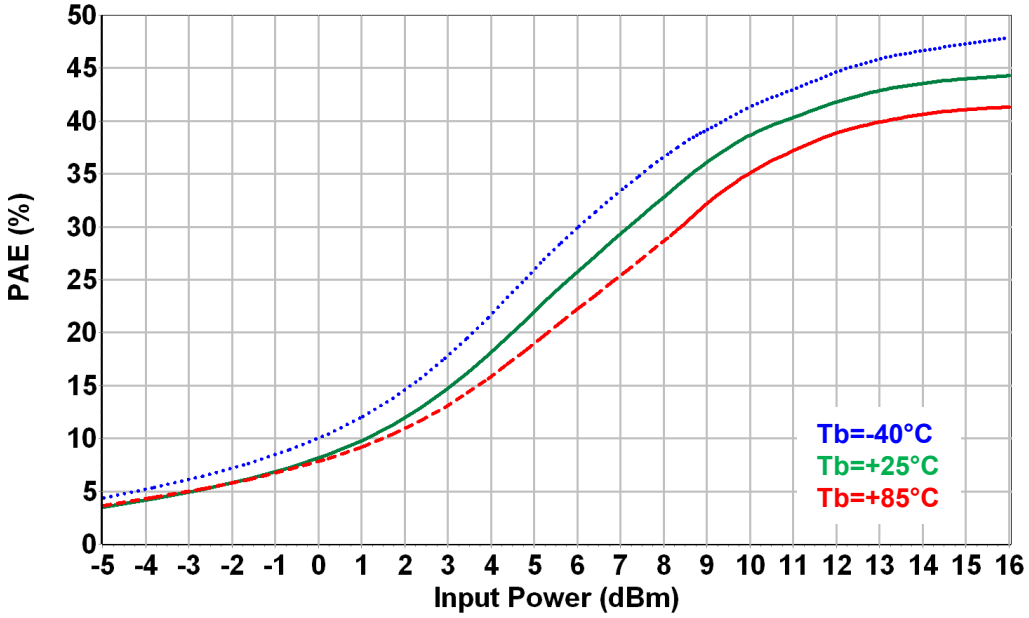


Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

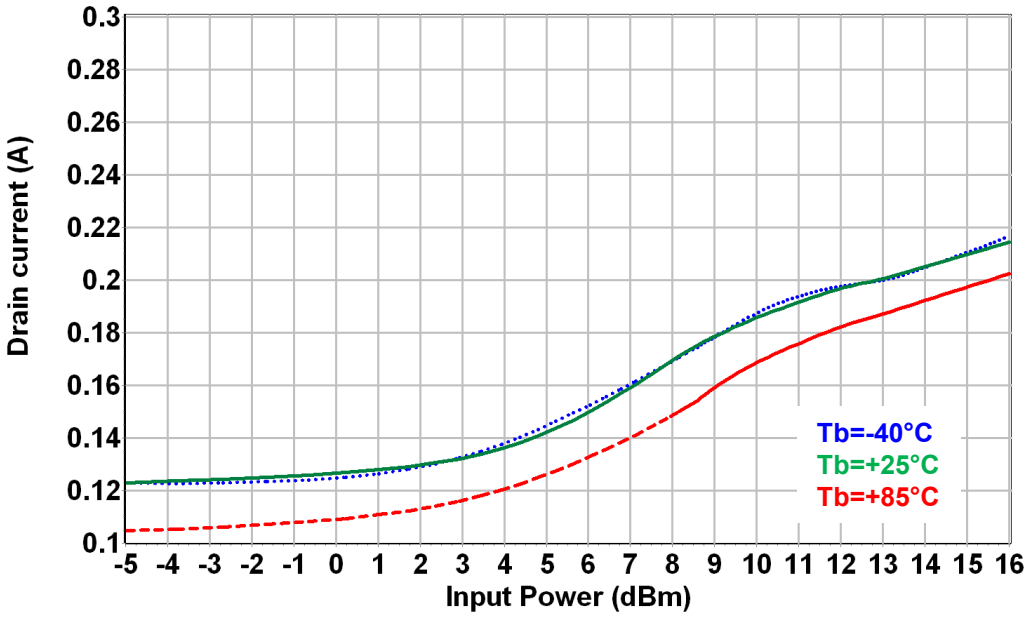
Typical Board Measurements: Power measurements

Biasing conditions: Vd = +7.5V, Idq = 120mA set at Tb=+25°C, kept constant vs temperature.
Test conditions at Tbackside = -40°C/+25°C/+85°C
Frequency : 1.3 GHz in CW measurements
Measurements are given in the connectors' access plans, using the board given in the paragraph "Evaluation board".

PAE versus input power and Temp

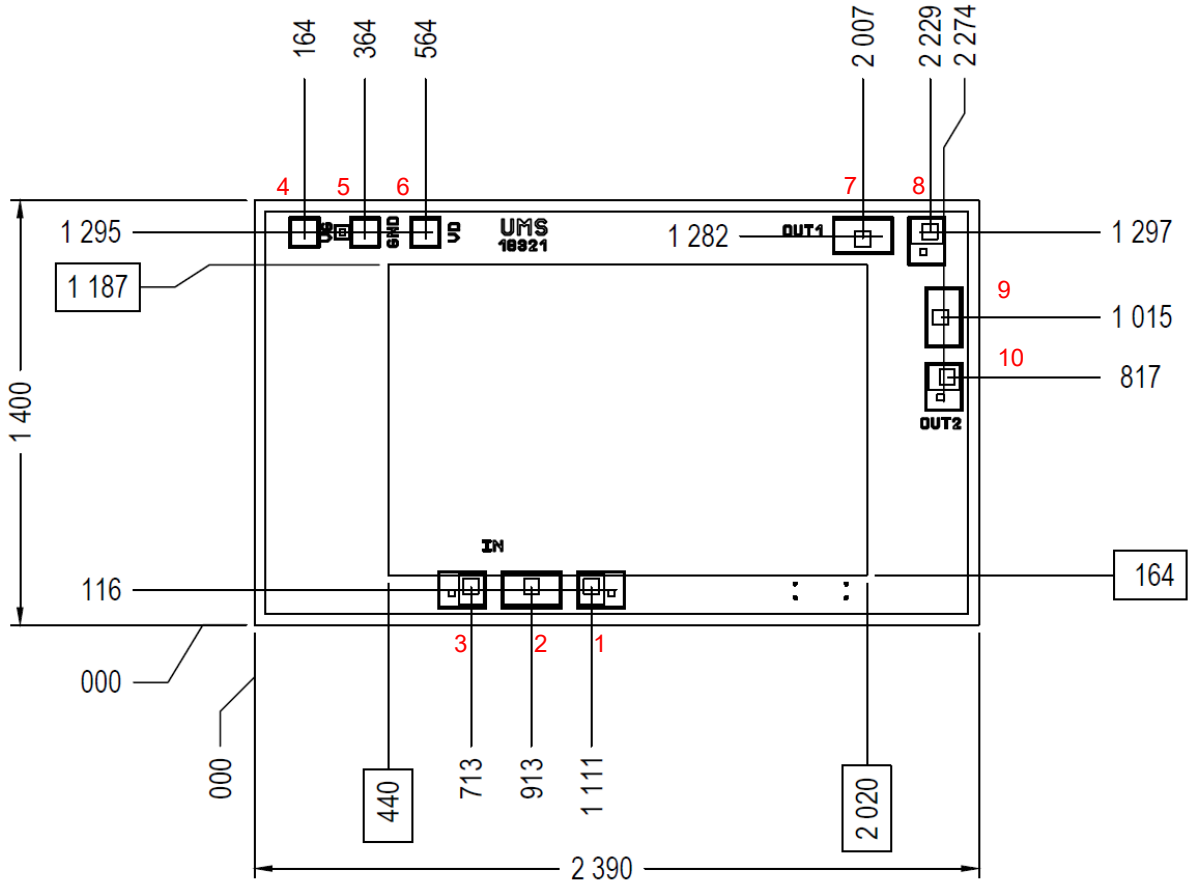


Drain current versus input power and Temp



Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

Mechanical Drawing



UNITS : μm
Tol : $\pm$35μm
XXX: Air Bridge Area

Chip thickness: 70µm
All dimensions are in micrometers
Chip size: 1400µm x 2390µm ±35µm

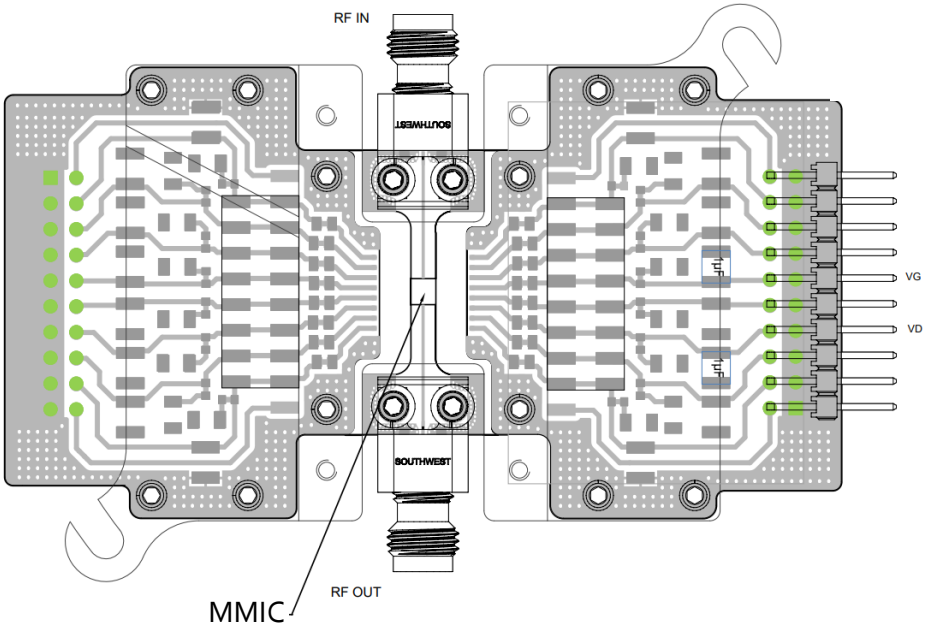
PAD Number	Name	Description	Pad size
2	IN	Input RF port (on West Side)	120µm x 200µm
4	VG	DC Gate voltage	100µm x 100µm
6	VD	DC Drain voltage	100µm x 100µm
7	OUT1	Output RF (on East Side)	120µm x 200µm
9	OUT2	Output RF (on South Side)	120µm x 200µm
1,3,8,10	GND	Ground from RF INOUT Cells	120µm x 88 µm
5	GND	Ground	100µm x 100µm

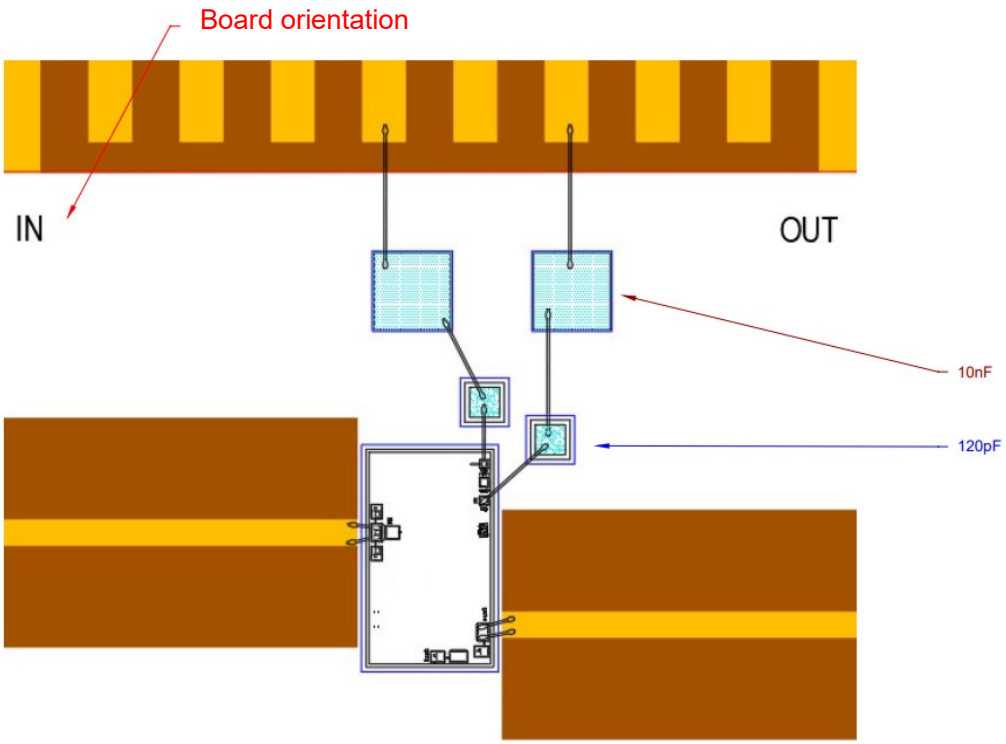
Note: only OUT1 or OUT2 must be used.

Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

Evaluation board

■ Decoupling capacitors of 100pF ±5% (chip capacitor), 10nF ±10% (chip capacitor) and 1µF ±10% (SMD capacitors) are recommended on Vg and Vd accesses.
■ See application note AN0030 for details on the evaluation board and board losses assessment.





Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

ESD sensitivity

Standard	Value
ESD STM5.1-1998 :	HBM Class 1A (between 250V and 500V)

Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com

Recommended reflow process assembly

Refer to the application note AN0001 available at https://www.ums-rf.com for die attach.

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 products.

Ordering Information

Chip form :	CHA5005-99F/XY Gelpack box: XY = 00

Bât. Charmille - Parc Mosaic - 10, Avenue du Québec - 91140 VILLEBON-SUR-YVETTE - France
Tel.: +33 (0) 1 69 86 32 00 - Fax: +33 (0) 1 69 86 34 34 - www.ums-rf.com