United Monolithic Semiconductors

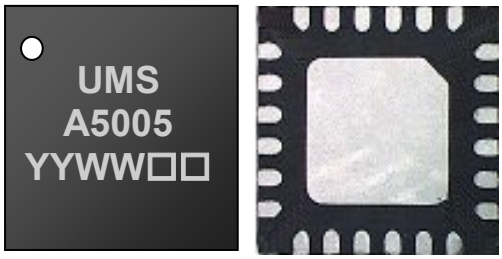
CHA5005-QDG

0.9-1.8GHz Medium Power Amplifier

GaAs Monolithic Microwave IC in SMD leadless package

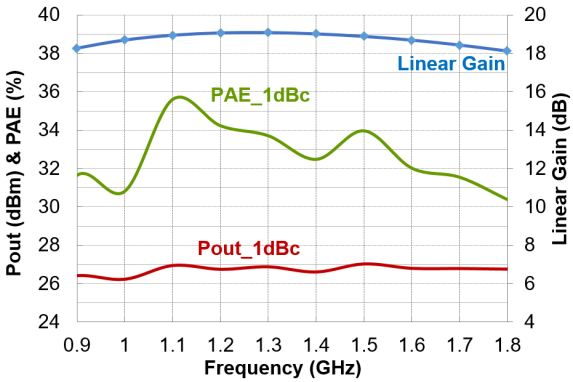
Description

The CHA5005-QDG 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 in RoHS compliant SMD package.



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
- 24L-QFN4x4
- MSL3



Main Electrical Characteristics

Tcase = +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		%

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Specifications

Tcase = +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)

Tcase = +25°C

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	9.5	V
Id_max	Drain current @ maximum input power	260	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	7.5	V
Id	Drain bias current	120	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.

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Temperature Range

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

Typical Bias Conditions

Tcase = +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 slowly 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

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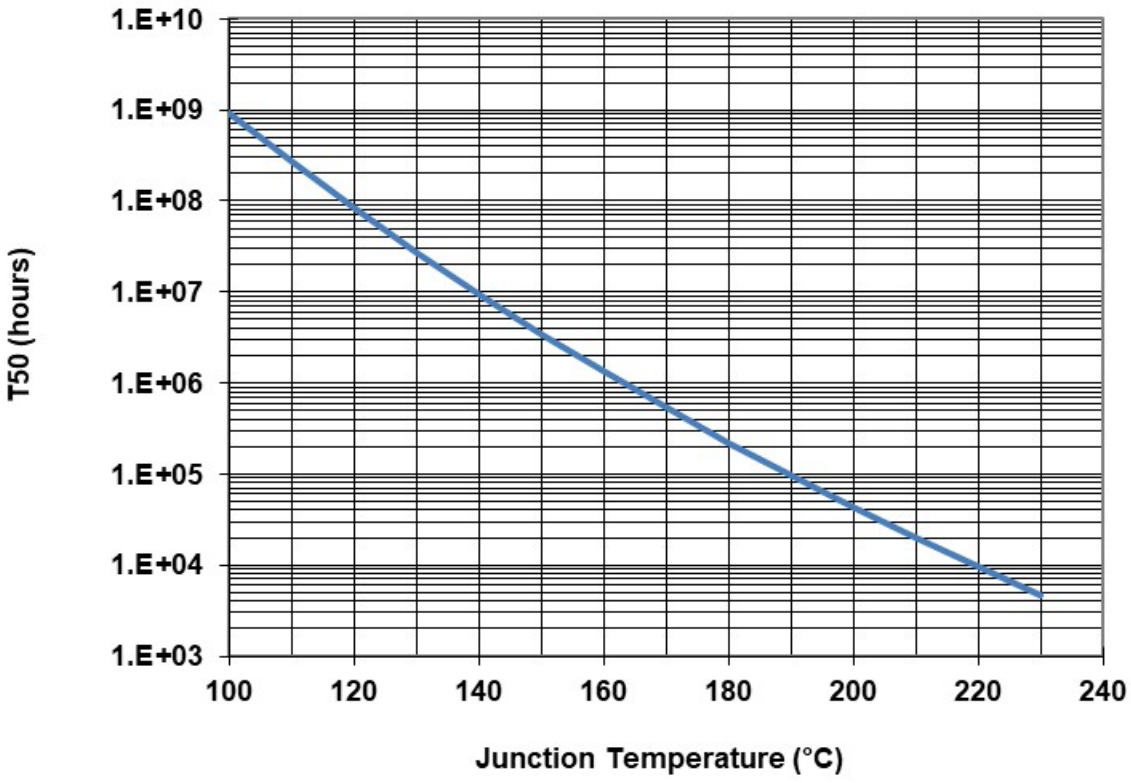
Device thermal performances

All the figures given in this section are obtained assuming that the QFN device is only cooled down by conduction through the package thermal pad (no convection mode considered).
The temperature is monitored at the package back-side interface (Tcase).
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 Case)	Vd= 7.5V Id= 120mA, Id_drive=210mA Pdiss= 1W CW	162.6	77.6	6.4E+05

(1) Assuming 85°C Tcase



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Typical Package Sij parameters

Tcase = +25°C, Vd = +7.5V, Id = 120mA

Freq (GHz)	S11 (dB)	PhS11 (°)	S12 (dB)	PhS12 (°)	S21 (dB)	PhS21 (°)	S22 (dB)	PhS22 (°)
0.1	-0.230	-19.6	-66.479	-147.7	-21.58	6.5	-0.191	-31.5
0.2	-0.584	-39.2	-54.113	-177.4	-8.15	-3.9	-0.819	-65.0
0.3	-1.306	-60.8	-44.607	172.0	2.79	-16.9	-3.195	-100.2
0.4	-2.688	-84.4	-37.816	135.1	9.63	-57.7	-6.739	-109.1
0.5	-5.997	-107.4	-33.599	118.5	12.47	-79.8	-6.549	-129.3
0.6	-8.786	-115.6	-29.703	80.6	16.87	-115.9	-9.655	-136.6
0.7	-12.931	-127.2	-29.153	53.2	17.32	-145.7	-9.312	-150.6
0.8	-16.336	-114.5	-28.515	34.1	17.70	-165.5	-10.382	-173.2
0.9	-16.307	-106.3	-27.871	16.5	18.27	176.7	-12.529	164.7
1	-15.954	-109.0	-27.459	-0.1	18.70	159.2	-15.378	142.0
1.1	-15.756	-115.0	-27.234	-15.8	18.95	142.6	-18.762	114.0
1.2	-15.323	-123.2	-27.169	-30.2	19.07	126.9	-21.668	72.2
1.3	-14.689	-133.3	-27.203	-44.0	19.09	111.9	-21.215	22.8
1.4	-13.790	-145.5	-27.305	-56.8	19.02	97.6	-18.436	-10.7
1.5	-12.772	-158.6	-27.486	-69.0	18.89	83.8	-15.798	-31.5
1.6	-11.681	-172.2	-27.734	-80.8	18.69	70.4	-13.675	-46.6
1.7	-10.573	174.4	-28.037	-92.2	18.44	57.5	-11.963	-59.1
1.8	-9.495	161.4	-28.389	-103.0	18.12	44.9	-10.569	-69.8
1.9	-8.483	149.1	-28.803	-113.4	17.76	32.8	-9.426	-79.8
2	-7.561	137.5	-29.251	-123.4	17.36	21.0	-8.481	-89.0
2.1	-6.735	126.6	-29.733	-133.0	16.91	9.7	-7.697	-97.7
2.2	-6.004	116.4	-30.253	-142.1	16.44	-1.3	-7.052	-106.0
2.3	-5.370	106.9	-30.778	-150.9	15.94	-11.9	-6.526	-113.8
2.4	-4.821	98.0	-31.328	-159.2	15.43	-22.2	-6.097	-121.2
2.5	-4.342	89.7	-31.872	-167.2	14.90	-32.1	-5.754	-128.2
2.6	-3.932	81.9	-32.423	-174.8	14.37	-41.7	-5.483	-134.9
2.7	-3.577	74.6	-32.955	177.9	13.85	-51.1	-5.269	-141.2
2.8	-3.267	67.8	-33.500	170.9	13.33	-60.2	-5.100	-147.2
2.9	-3.006	61.3	-34.007	164.2	12.81	-69.2	-4.981	-152.9
3	-2.781	55.2	-34.516	157.6	12.31	-78.0	-4.892	-158.3
3.1	-2.585	49.5	-35.002	151.0	11.80	-86.7	-4.836	-163.4
3.2	-2.416	44.0	-35.456	144.7	11.31	-95.4	-4.793	-168.2
3.3	-2.267	38.9	-35.889	138.5	10.82	-103.9	-4.774	-172.7
3.4	-2.143	33.9	-36.310	132.2	10.34	-112.5	-4.752	-177.0
3.5	-2.033	29.2	-36.734	126.3	9.84	-121.1	-4.735	179.0
3.6	-1.941	24.6	-37.139	120.1	9.35	-129.7	-4.703	175.1
3.7	-1.859	20.3	-37.551	113.9	8.84	-138.4	-4.664	171.4
3.8	-1.788	16.1	-37.983	107.9	8.31	-147.1	-4.601	167.9
3.9	-1.725	12.1	-38.365	101.5	7.76	-155.9	-4.513	164.3
4	-1.669	8.3	-38.766	95.5	7.17	-164.7	-4.413	160.6

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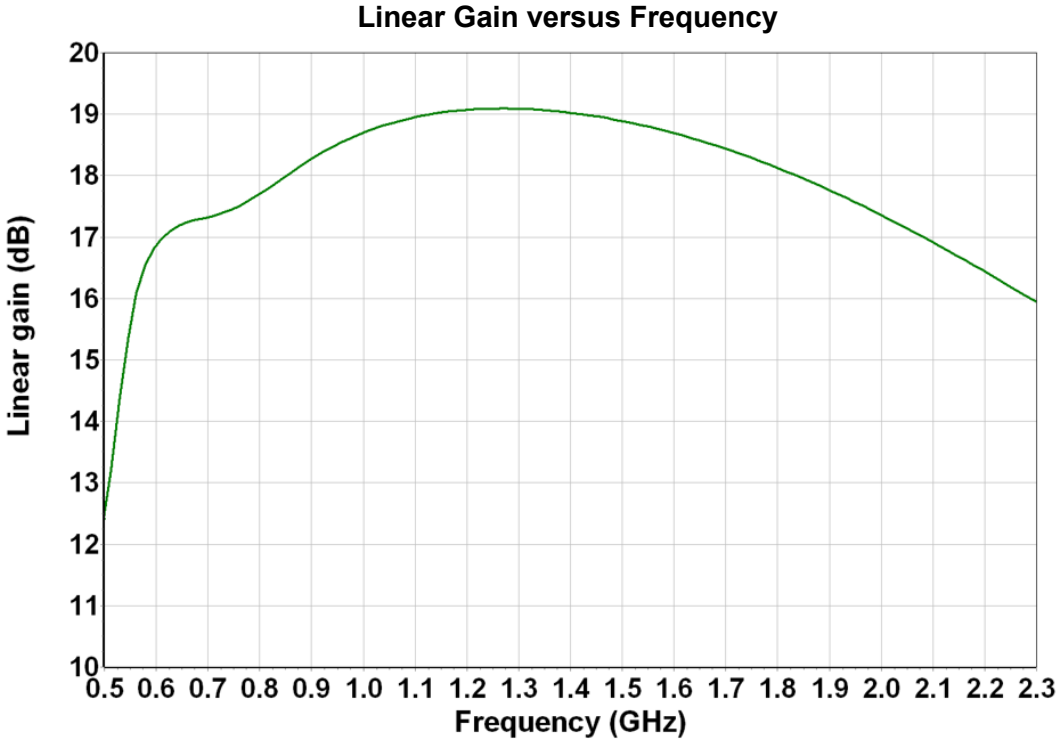
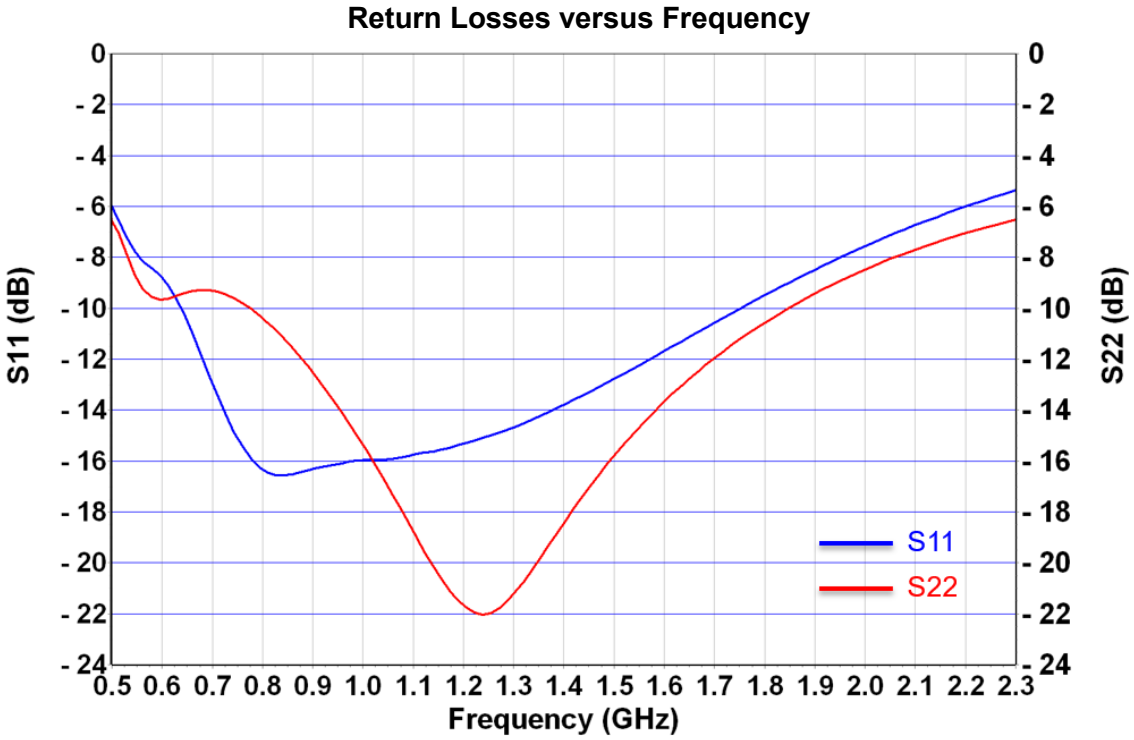
Typical Board Measurements

Tcase = +25°C, Vd = +7.5V, Id = 120mA





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Typical Board Measurements

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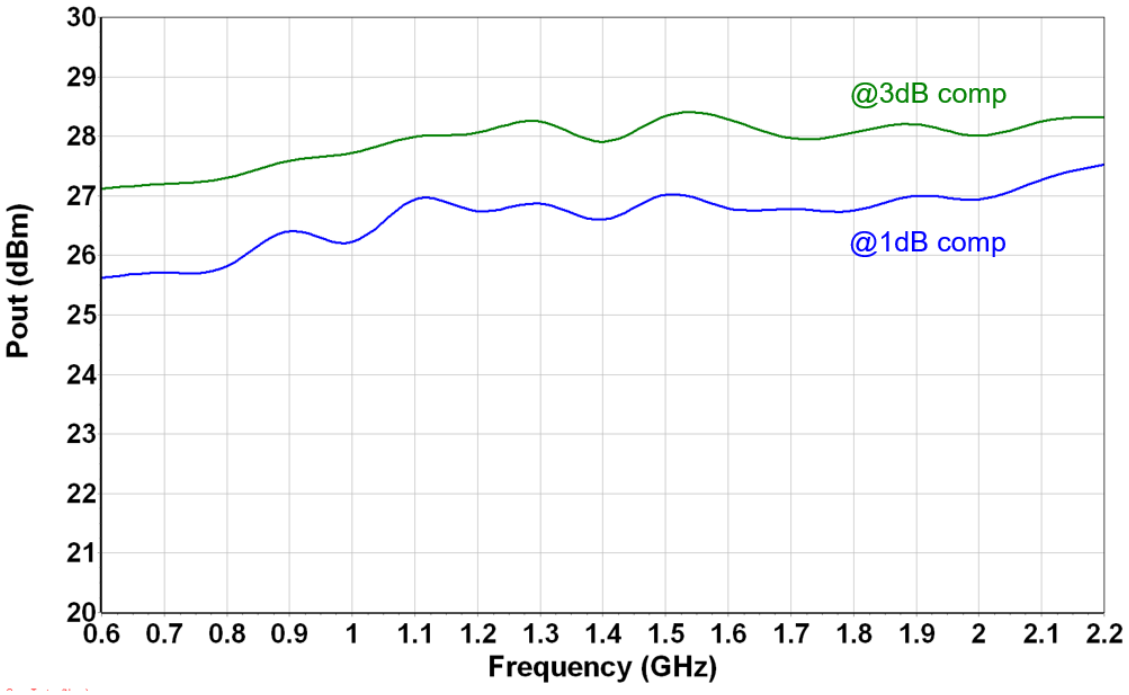
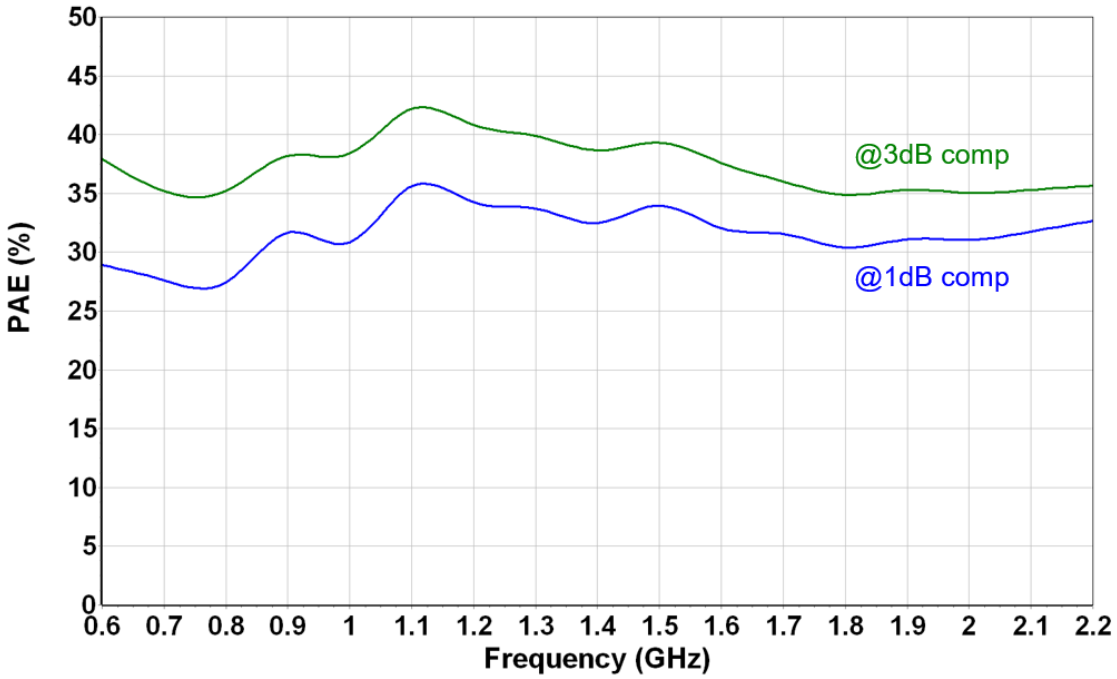
Output Power @ 1dB & 3dB gain compression versus Frequency



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



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Typical Board Measurements

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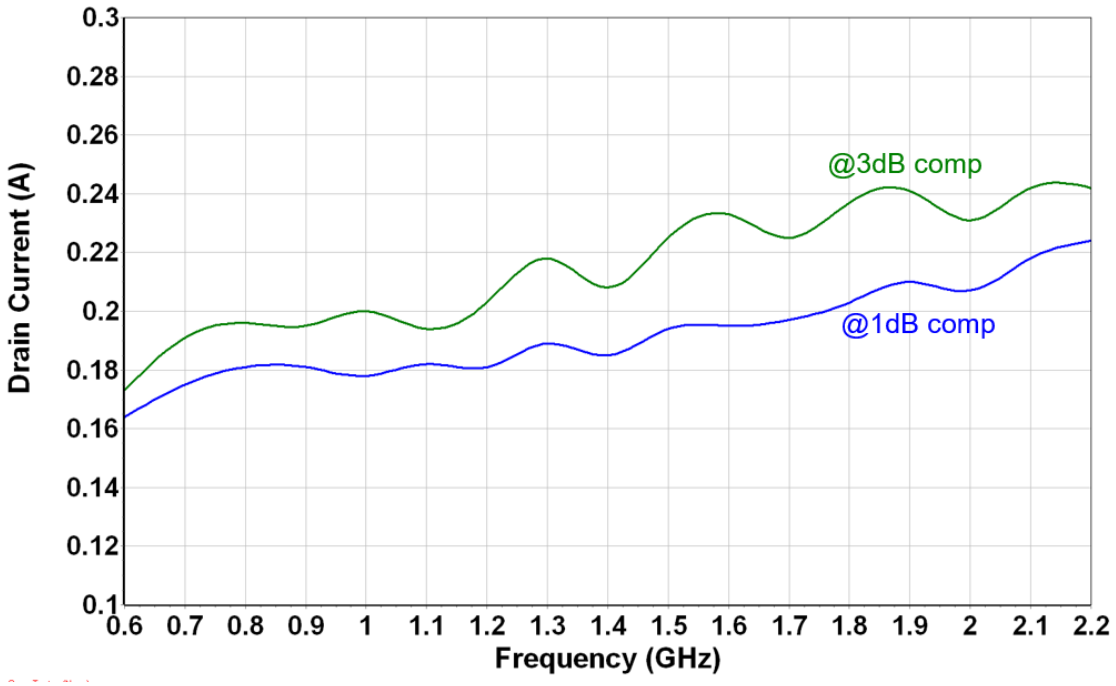
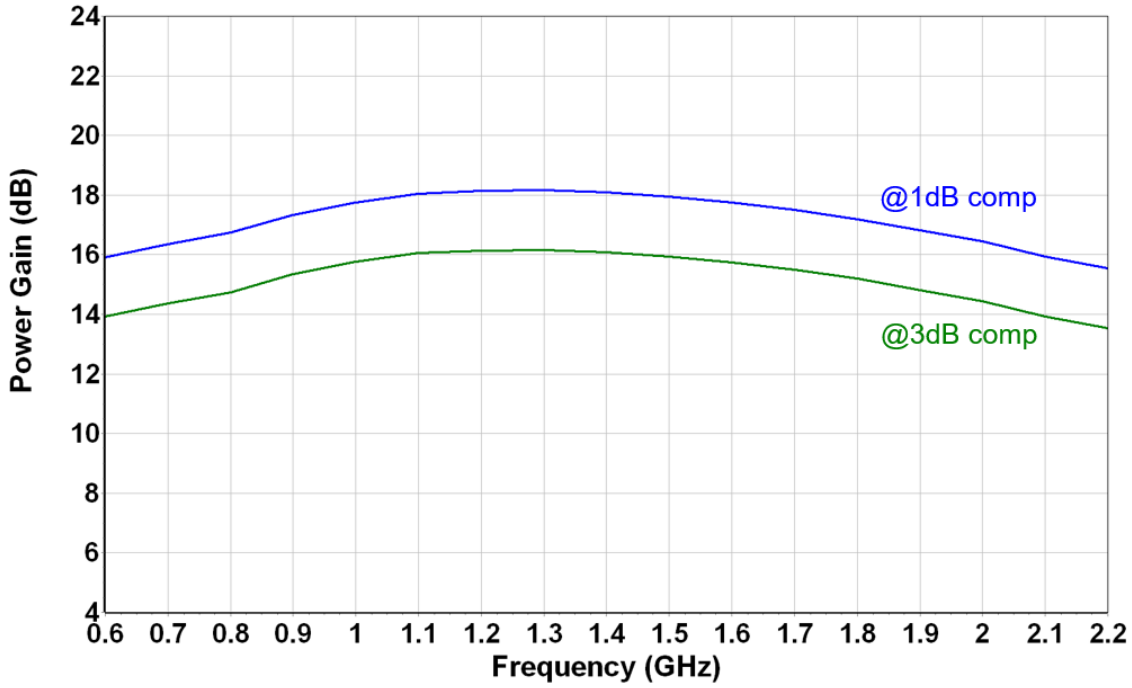
Drain Current @ 1dB & 3dB gain compression versus Frequency



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



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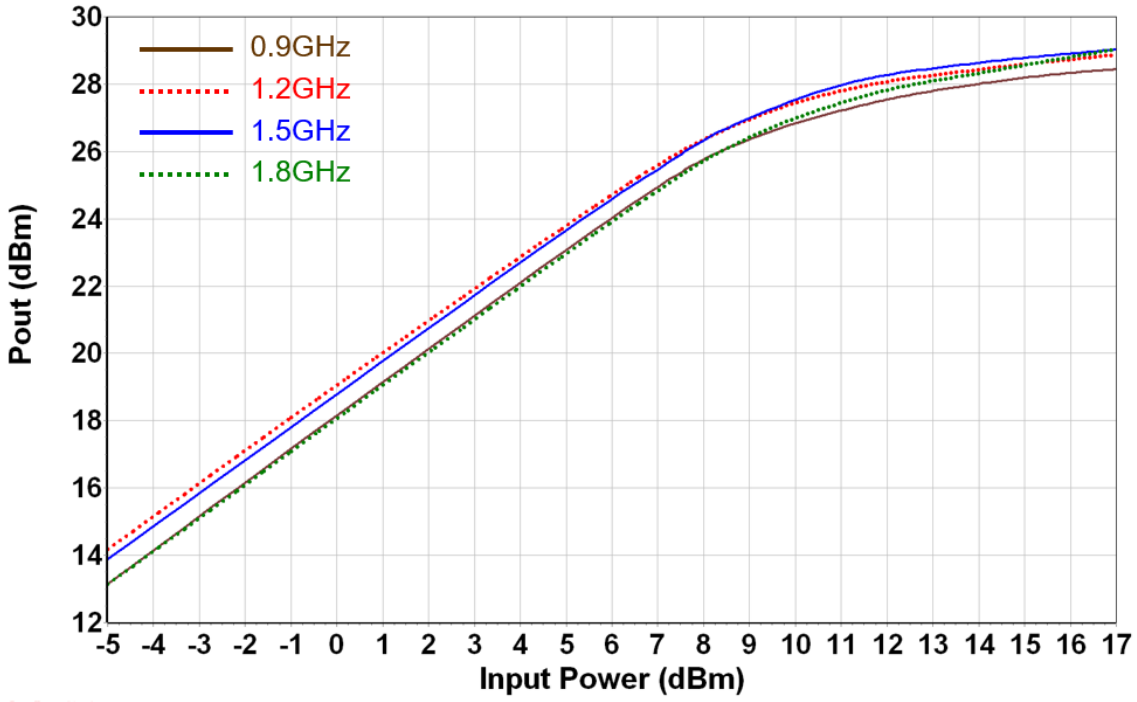
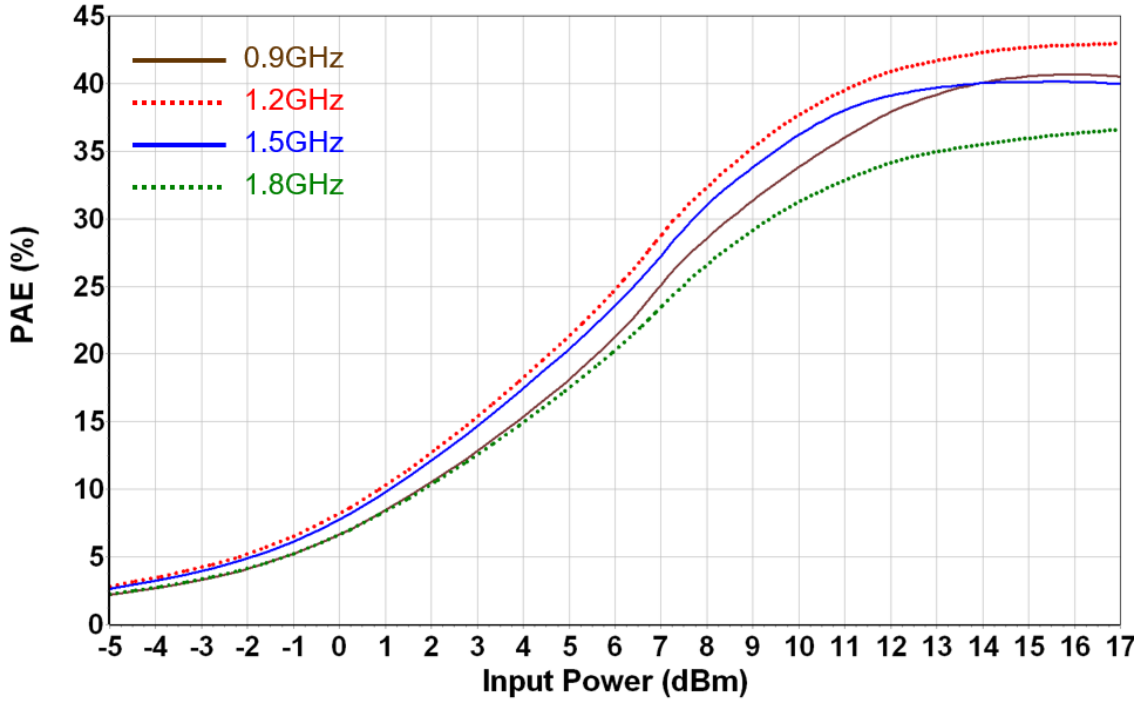
Typical Board Measurements

Tcase = +25°C, Vd = +7.5V, Id = 120mA

Output Power versus Input Power versus Frequency



Power Added Efficiency versus Input Power versus Frequency



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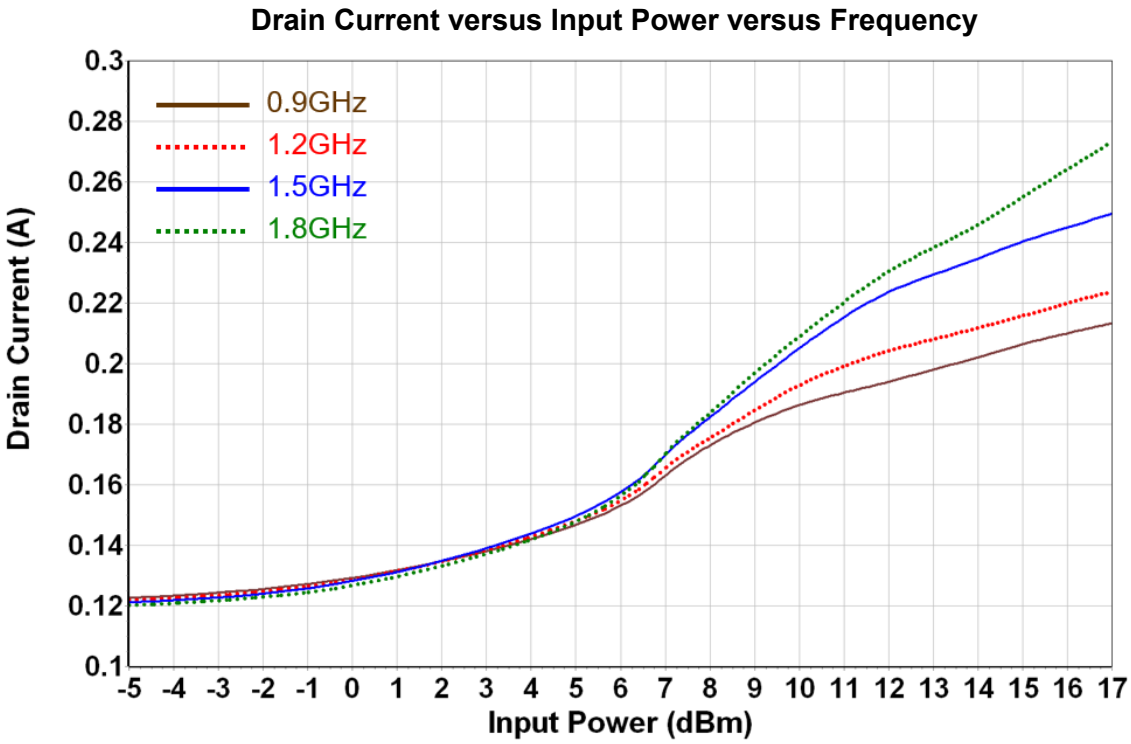

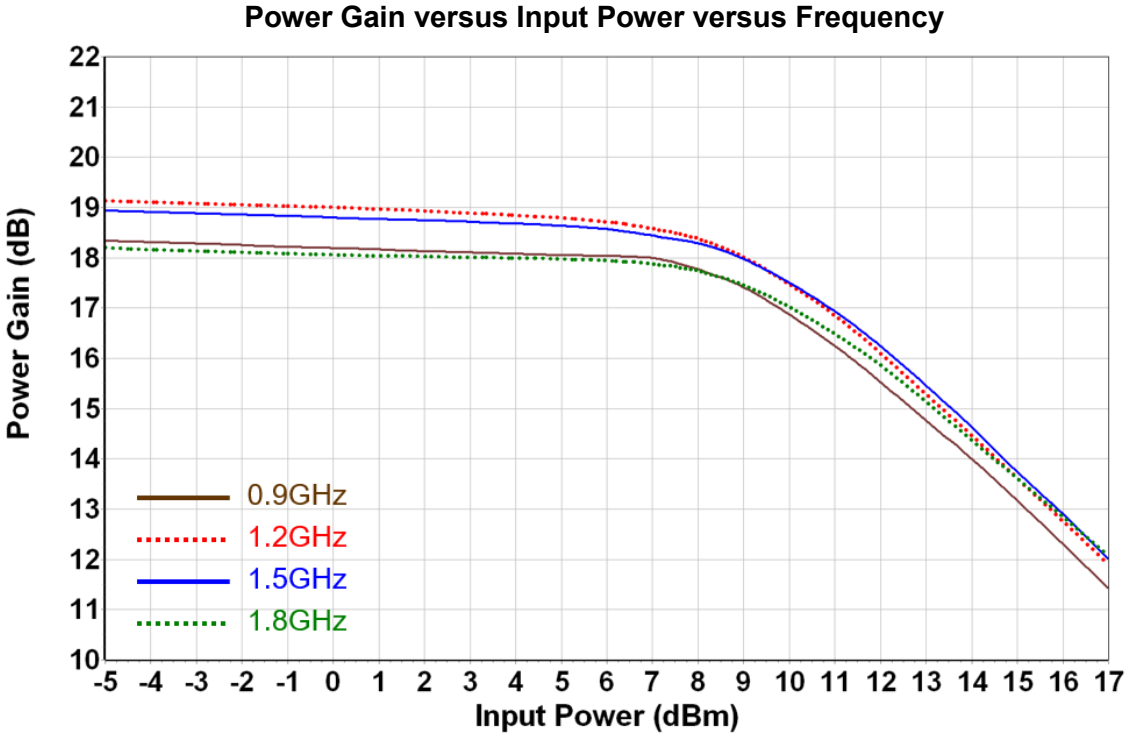

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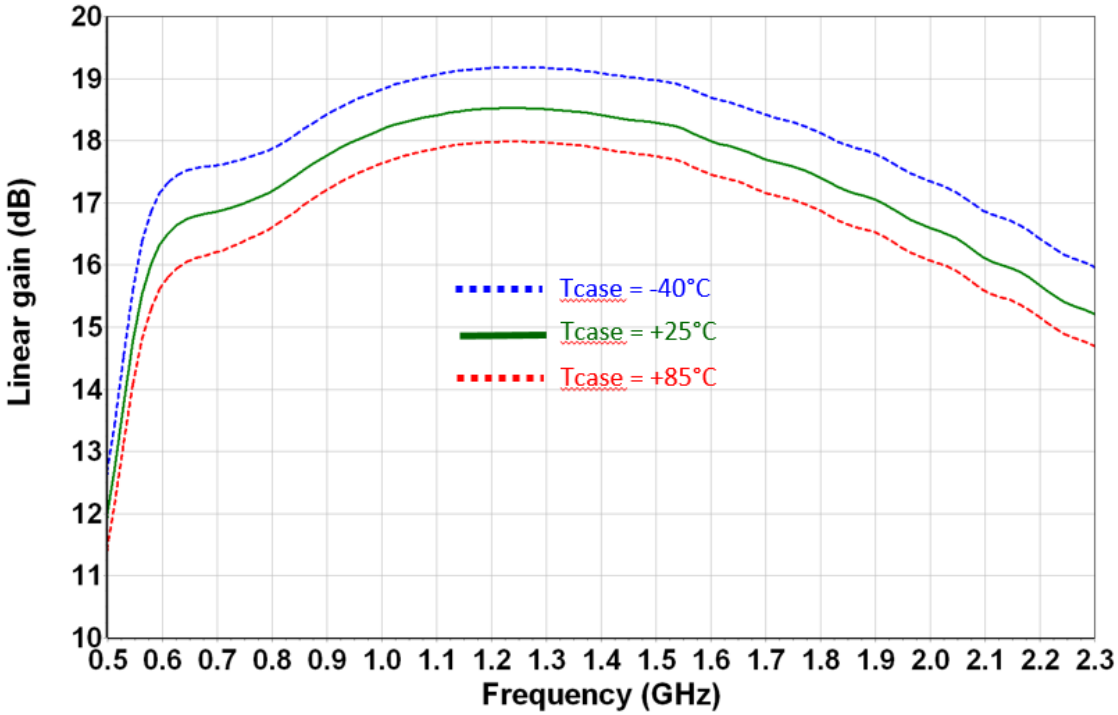
Typical Board Measurements

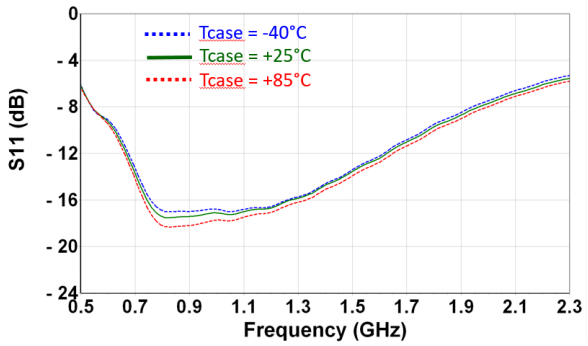
Vd = +7.5V, Id = 120mA
Tcase = -40°C, +25°C, +85°C

Measurements with temperature are given in the connectors' access plans, using the proposed land pattern and board given in the paragraph "Evaluation mother board".

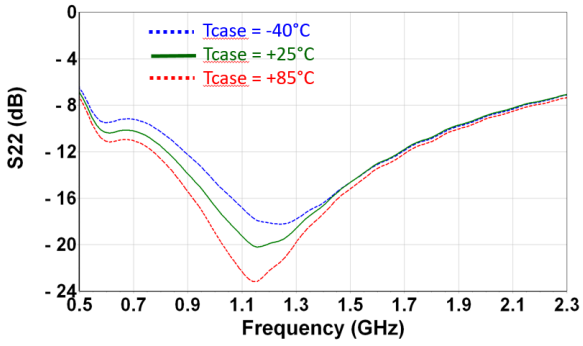
Linear Gain versus Frequency & Temperature



Input Return Loss versus Frequency



Output Return Loss versus Frequency



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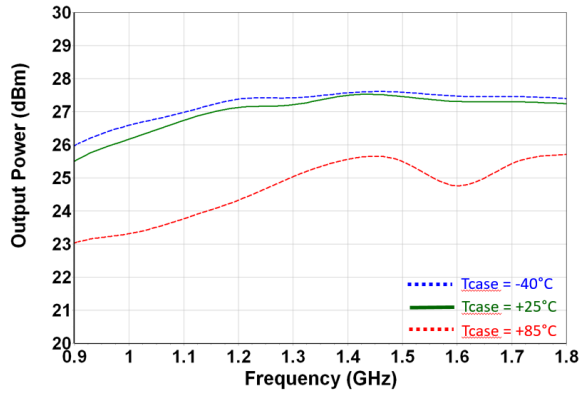
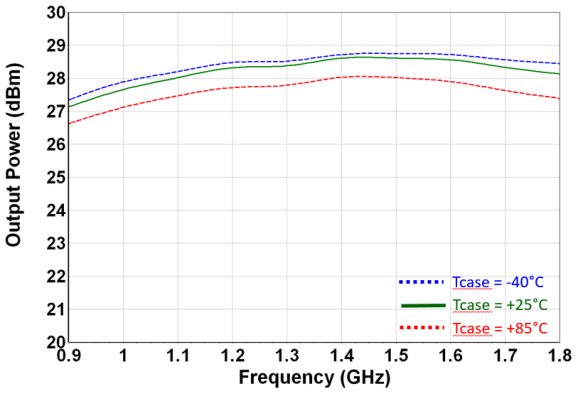
Typical Board Measurements

Vd = +7.5V, Id = 120mA
Tcase = -40°C, +25°C, +85°C

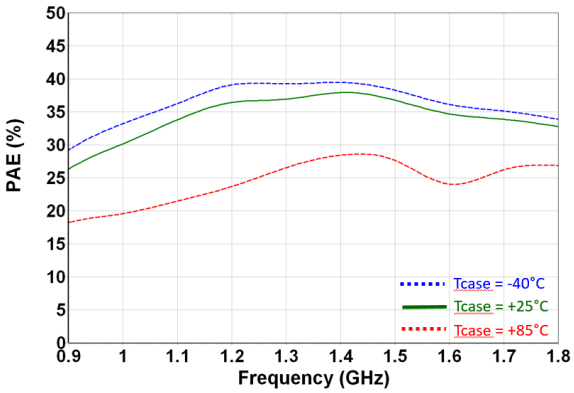
Output Power @ 1dB comp.



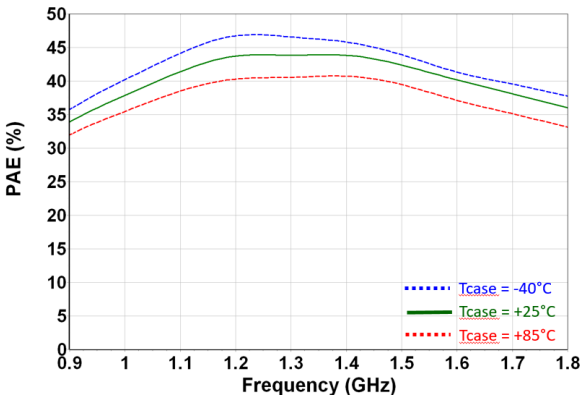
Output Power @ 3dB comp.



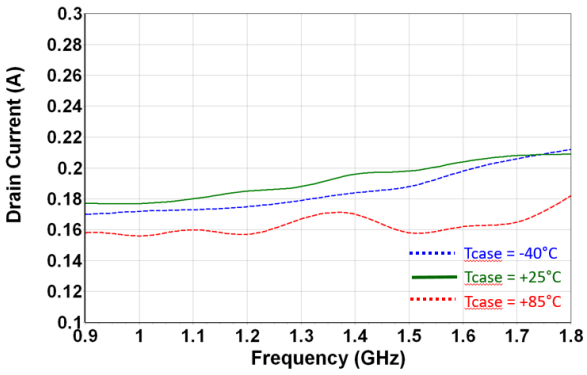
PAE @ 1dB comp. versus Frequency



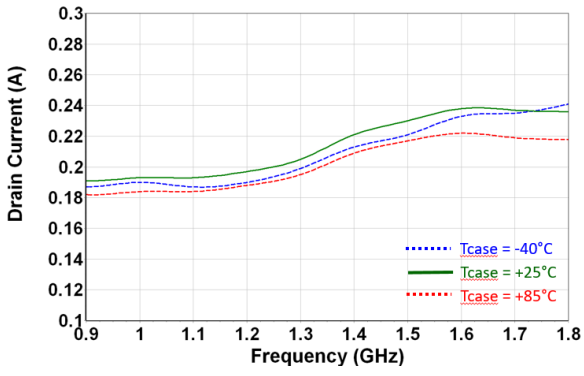
PAE @ 3dB comp. versus Frequency



Drain Current @ 1dB comp.



Drain Current @ 3dB comp.



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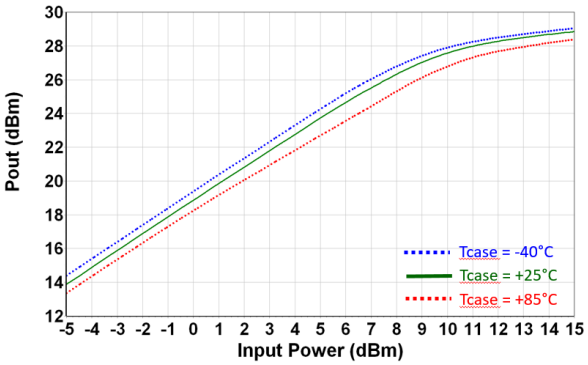
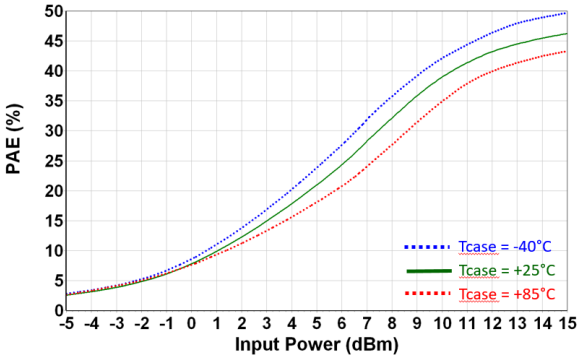
Typical Board Measurements

Vd = +7.5V, Id = 120mA
Tcase = -40°C, +25°C, +85°C
Frequency = 1.3GHz

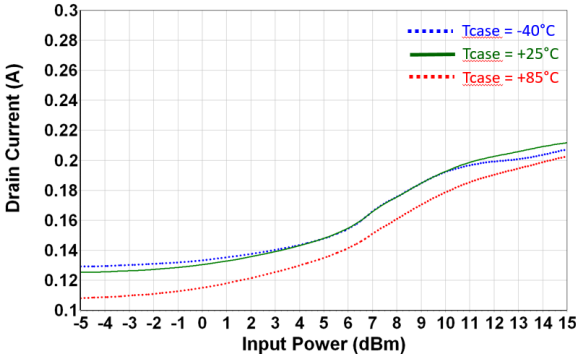
Output Power versus Input Power



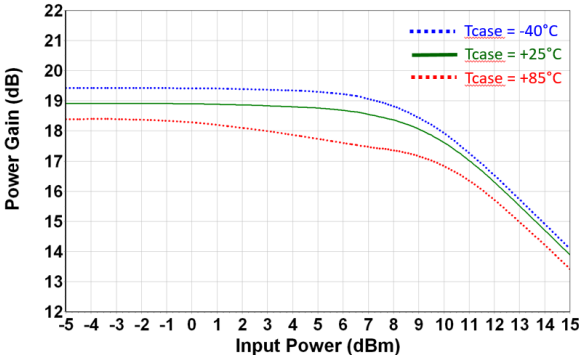
PAE versus Input Power



Drain Current versus Input Power



Power Gain versus Input Power



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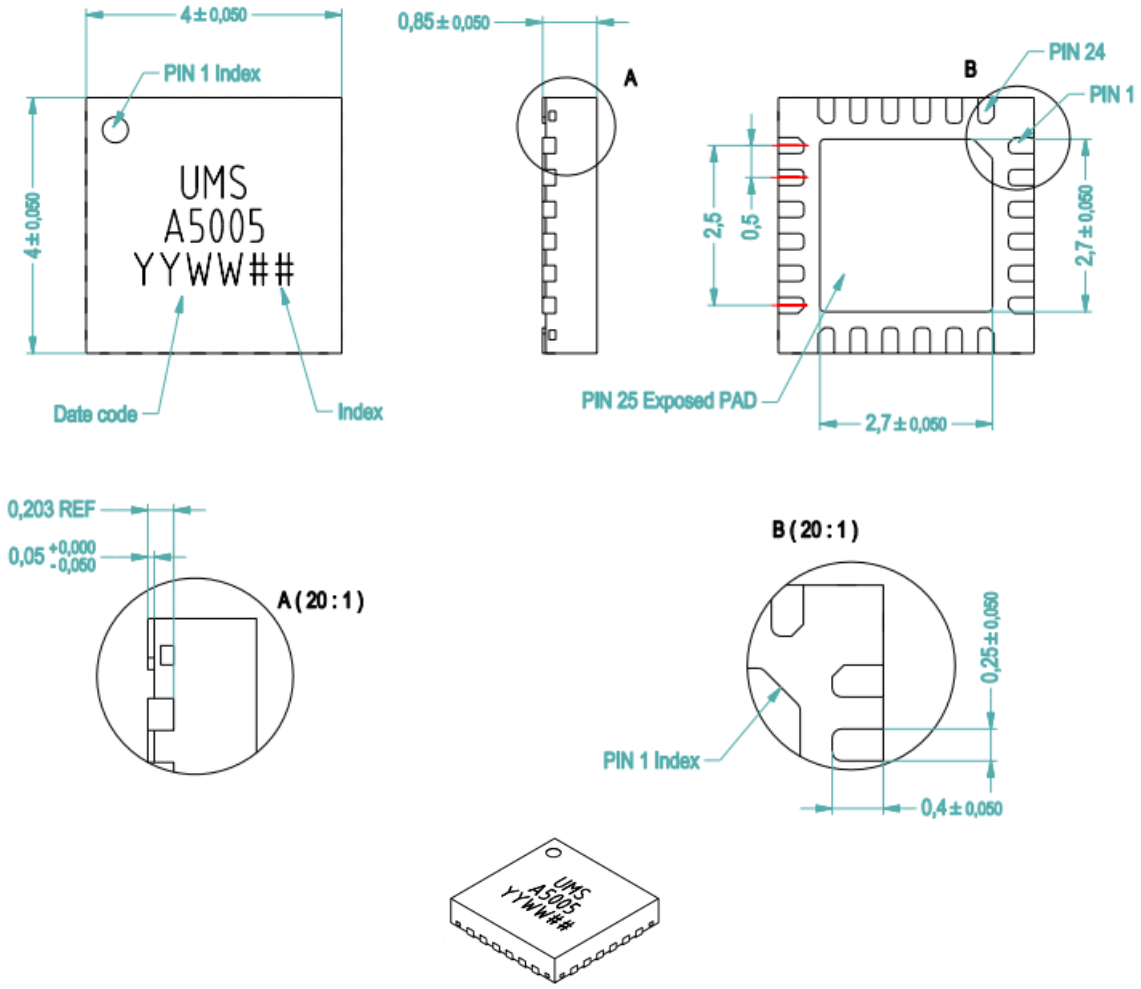
Package outline (1)



Matte tin, Lead Free	(Green)	1- Nc	11- Nc	21- Nc
Units :	mm	2- Nc	12- Nc	22- Vd
From the standard :	JEDEC MO-220	3- Nc	13- Nc	23- Gnd(2)
	(VGGD)	4- Nc	14- Nc	24- Vg
25-	GND	5- Gnd(2)	15- Nc	
		6- RF in	16- Gnd(2)	
		7- Nc	17- RF out	
		8- Nc	18- Nc	
		9- Gnd(2)	19- Nc	
		10- Nc	20- Nc	

(1) The package outline drawing included to this data-sheet is given for indication. Refer to the application note AN0017 (https://www.ums-rf.com) for exact package dimensions.

(2) It is strongly recommended to ground all pins marked “Gnd” through the PCB board. Ensure that the PCB board is designed to provide the best possible ground to the package.

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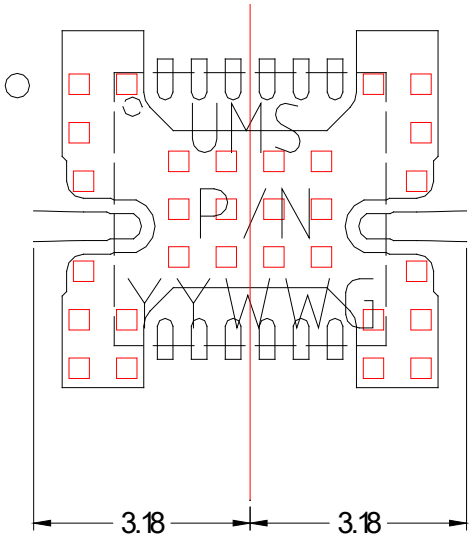
Definition of the Sij reference planes

The reference planes used for Sij measurements given above are symmetrical from the symmetrical axis of the package (see drawing beside). The input and output reference planes are located at 3.18mm offset (input wise and output wise respectively) from this axis. Then, the given Sij parameters incorporate the land pattern of the evaluation motherboard recommended in paragraph "Evaluation mother board".



ESD sensitivity

Standard	Value
MIL-STD-1686C	HBM Class 1 (<2000V)
ESD STM5.1-1998	HBM Class 0 (<250V)

Package Information

Parameter	Value
Package body material	RoHS-compliant
	Low stress Injection Molded Plastic
Lead finish	100% matte tin (Sn)
MSL Rating	MSL3

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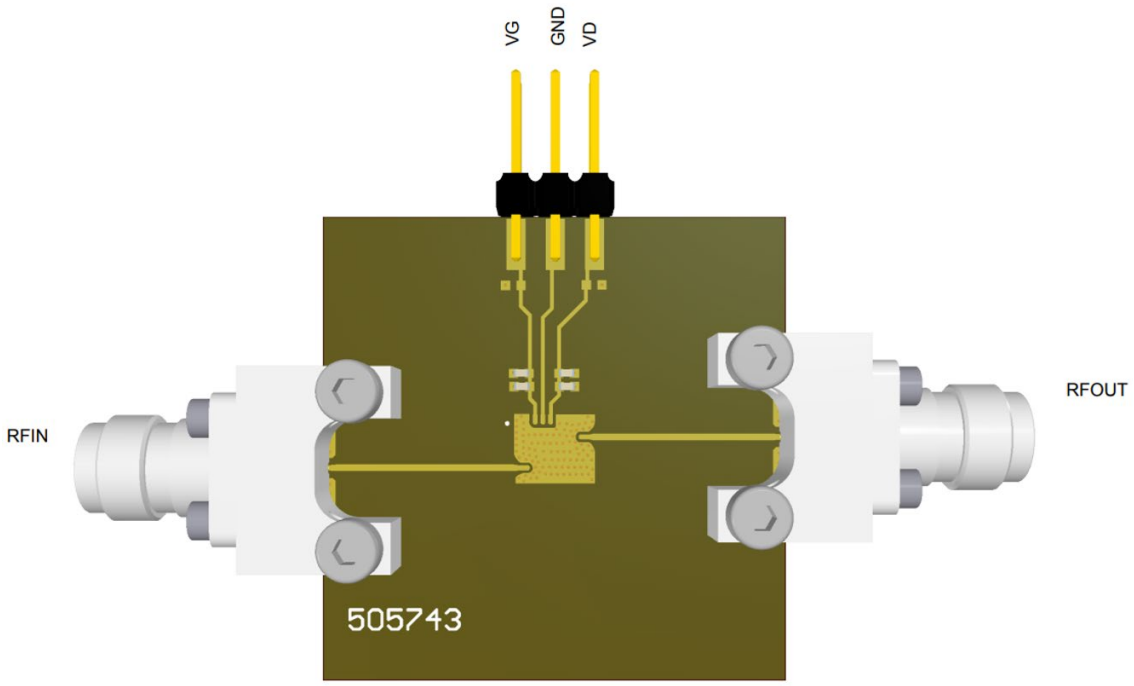
Evaluation mother board

- Compatible with the proposed footprint.
- Based on typically Ro4003 / 8mils or equivalent.
- Using a micro-strip to coplanar transition to access the package.
- Recommended for the implementation of this product on a module board.
- Decoupling capacitors of 100pF ±5%, 10nF ±10% and 1µF ±10% are recommended for all DC accesses.
- See application note AN0017 for details.



Note: All board measurements are performed using shielded cables, even for DC bias, to ensure safe operation.

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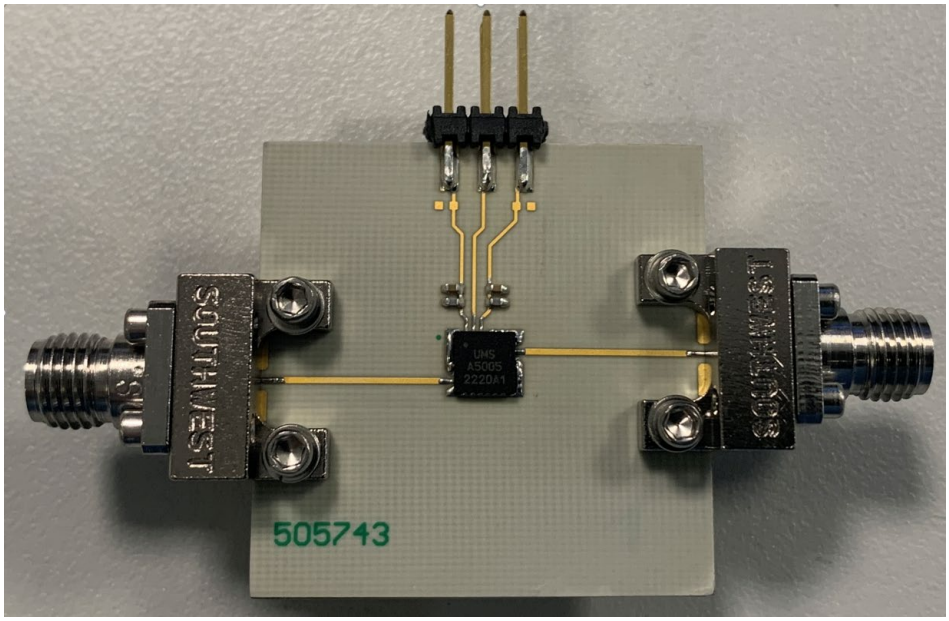
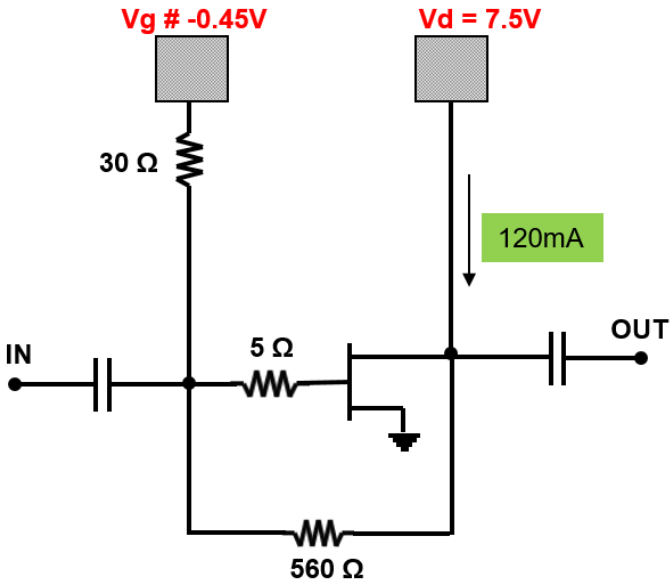
Picture of evaluation mother board



DC Schematic of the Medium Power Amplifier



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Recommended package footprint

Refer to the application note AN0017 available at https://www.ums-rf.com for package foot print recommendations.

SMD mounting procedure

For the mounting process standard techniques involving solder paste and a suitable reflow process can be used. For further details, see application note AN0017 at https://www.ums-rf.com.

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

QFN 4x4 package:	CHA5005-QDG/XY	
	Stick: XY = 20	Tape & reel: XY = 21

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