United Monolithic Semiconductors

CHA5282-QAG

17-21.5GHz Medium Power Amplifier

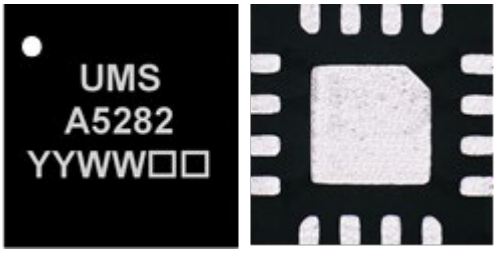
GaAs Monolithic Microwave IC in SMD leadless package

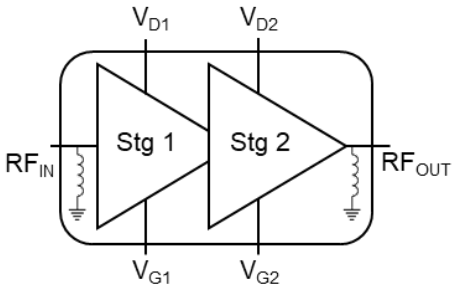
Description

The CHA5282-QAG is a two-stage GaAs Medium Power Amplifier in the frequency band 17-21.5GHz. This MPA typically provides 25dBm output power associated to 44% of Power Added Efficiency. The circuit exhibits a typical small signal gain of 18.5dB. The overall power supply is 5V/70mA. It is available in 3x3 plastic package.

The circuit is dedicated to space applications and also well suited for a wide range of microwave and millimetre wave applications and systems, like point to point.

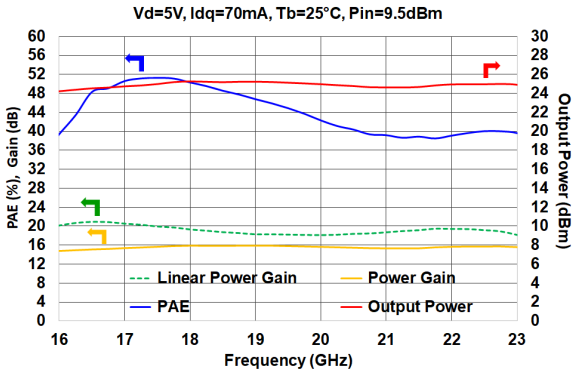
It is developed on a robust pHEMT process. The input and output are matched to 50Ω and integrate ESD RF protection.





Main Features

- Broadband performances: 17-21.5GHz
- 25dBm Pout at 3dB compression
- Associated PAE=44%
- DC bias: Vd=5Volt@Idq=70mA
- 16Leads-QFN 3x3mm²
- MSL1



Main Electrical Characteristics

Tcase = +25°C

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	17		21.5	GHz
Gain	Linear Gain		18.5		dB
Pout	Output Power @3dB comp.		25		dBm
PAE	PAE @3dB comp.		44		%

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Specifications

T_{case} = 25°C, Vd = 5V, Idq=70mA CW mode

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	17		21.5	GHz
Gain	Small signal Gain		18.5		dB
S11	Input Return loss		8		dB
S22	Output return loss		15		dB
P_{1dB}	Output Power at 1dBc		23		dBm
P_{sat}	Output Power at 3dBc		25		dBm
PAE	Power Added Efficiency at 3dBc		44		%
AMPM	Phase shift at 3dBc		18		°
NPR	NPR at Pout=22.5dBm		15		dB
Idq	Quiescent Current		70		mA

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

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Absolute Maximum Ratings (1)

Tcase = +25°C

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	8	V
Idq	Quiescent Drain current	150	mA
Vg	Gate bias voltage	-2.5 to 0	V
Pin	Maximum peak input power overdrive	17	dBm

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

Recommended Operating Range (2), (3)

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	4 to 6	V
Idq	Quiescent Drain current	50 to 80	mA
Pin	Maximum peak input power overdrive	15	dBm
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 Performance section

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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 Nº	Parameter	Values	Unit
Vg	5,7	Gate supply voltage	-0.6	V
Vd	14,16	Drain supply voltage	5	V

“Power ON” sequence

1. Ground the device
2. Set the Gate voltage to -1.5V
3. Apply the Drain voltage Vd (Typically 5V)
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 -1.5V
3. Decrease the Drain voltage to 0V
4. Turn off Vd supply
5. Turn off Vg supply

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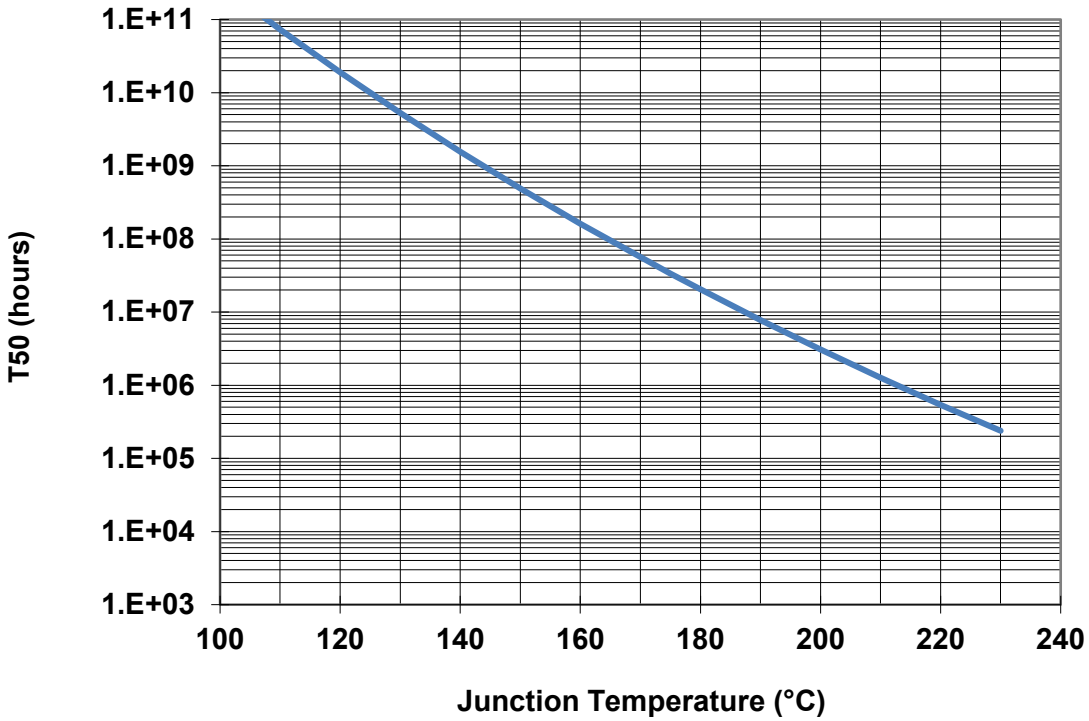
Device thermal performance

All the figures given in this section are obtained assuming that the die is only cooled down by conduction through the package case.
The temperature is monitored at the QFN back-side interface (T_{case}).
For nominal operating, the system maximum temperature must be adjusted in order to guarantee that $T_{junction}$ remains below the maximum value specified in the Recommended Operating Ratings table.
So, the system PCB must be designed to comply with this requirement.

Parameter	Biasing conditions	$T_{junction}$ (°C)	R_{TH} (°C/W)	T_{50} (hours)
R_{TH} (1) Thermal Resistance (Junction to Case)	Vd= 5V Pout= 25dBm Pdiss= 0.47W	148	135	6.14e8
	Vd= 5V Idq=70mA noRF Pdiss= 0.35W	131.5	133	4.38e9

(1) Assuming 85°C Tcase



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Typical Package Sij parameters

Tcase=+25°C, Vd = +5V, Idq = 70mA

Freq (GHz)	S11 (dB)	PhS11 (°)	S12 (dB)	PhS12 (°)	S21 (dB)	PhS21 (°)	S22 (dB)	PhS22 (°)
2.0	-3.6	120.5	-60.6	117.6	-29.4	-101.2	-1.0	-10.6
3.0	-1.8	37.3	-52.3	79.6	-51.4	-62.8	-0.6	-38.9
4.0	-1.1	-18.5	-50.9	37.3	-37.9	96.9	-0.5	-64.3
5.0	-0.7	-50.8	-51.1	14.5	-22.0	87.8	-0.3	-77.0
6.0	-0.6	-65.5	-51.5	3.8	-12.3	35.1	-0.4	-90.8
7.0	-0.7	-76.2	-50.8	-13.9	-7.7	-16.8	-0.7	-108.1
8.0	-1.0	-99.5	-49.3	-28.9	-4.6	-59.8	-1.0	-126.8
9.0	-0.9	-138.4	-50.9	-65.2	-3.9	-106.7	-1.1	-155.6
10.0	-0.8	-151.3	-51.4	-72.3	-1.9	-133.2	-1.4	-166.7
11.0	-1.0	-161.7	-52.0	-74.0	1.0	-157.6	-1.9	-177.4
12.0	-1.5	-177.9	-51.0	-82.4	5.0	169.7	-3.2	162.4
13.0	-2.2	152.7	-49.2	-102.1	8.5	127.0	-4.4	130.6
14.0	-2.5	126.9	-48.6	-115.2	11.4	83.6	-5.5	98.3
15.0	-2.9	112.7	-46.6	-137.8	14.9	44.7	-7.8	88.3
16.0	-6.9	102.1	-43.1	177.0	19.9	-20.6	-12.1	113.4
17.0	-8.8	108.9	-42.4	116.9	20.3	-93.9	-12.1	123.7
18.0	-9.5	70.9	-43.2	55.5	19.1	-152.5	-18.5	73.7
19.0	-8.5	37.5	-42.9	4.9	17.9	158.5	-22.4	-19.1
20.0	-8.8	21.3	-41.4	-38.9	17.6	113.4	-28.2	-36.9
21.0	-11.5	33.9	-39.4	-80.4	18.4	63.7	-20.8	132.2
22.0	-9.8	52.7	-37.6	-132.3	19.2	-0.2	-13.6	88.4
23.0	-8.4	0.3	-38.2	167.3	17.8	-79.6	-23.7	-22.5
24.0	-7.0	-88.6	-43.2	122.9	12.0	-150.0	-12.8	-129.1
25.0	-5.4	-122.8	-47.0	105.7	5.9	163.4	-9.1	-143.4
26.0	-6.6	-141.6	-49.0	85.3	1.2	122.3	-9.5	-179.7
27.0	-6.9	166.7	-51.0	68.4	-3.4	79.0	-8.3	153.6
28.0	-4.8	127.1	-52.7	47.4	-9.0	37.6	-5.2	126.7
29.0	-3.2	109.6	-55.1	32.1	-14.8	4.8	-4.1	117.4
30.0	-3.4	87.6	-52.5	24.3	-20.7	-22.4	-2.8	110.7
31.0	-4.8	52.6	-53.1	-21.4	-27.0	-45.0	-3.0	97.0
32.0	-7.7	5.7	-55.3	-53.4	-31.1	-38.5	-2.7	76.0
33.0	-10.1	50.9	-56.0	-110.3	-30.5	-70.6	-2.2	39.8
34.0	-3.6	50.2	-57.6	162.1	-36.0	-109.5	-1.3	28.5
35.0	-2.4	41.5	-54.3	110.4	-41.3	-126.6	-0.6	24.6
36.0	-2.2	16.4	-49.7	75.4	-51.8	-160.3	-1.0	26.2
37.0	-2.2	-18.3	-47.6	31.7	-62.7	62.0	-1.3	6.0
38.0	-1.2	-42.1	-49.2	4.0	-56.5	-40.2	-1.6	-27.4
39.0	-0.8	-51.2	-50.5	4.8	-57.9	-38.5	-0.7	-45.5
40.0	-0.7	-49.0	-48.8	15.3	-49.2	26.6	-0.5	-56.9

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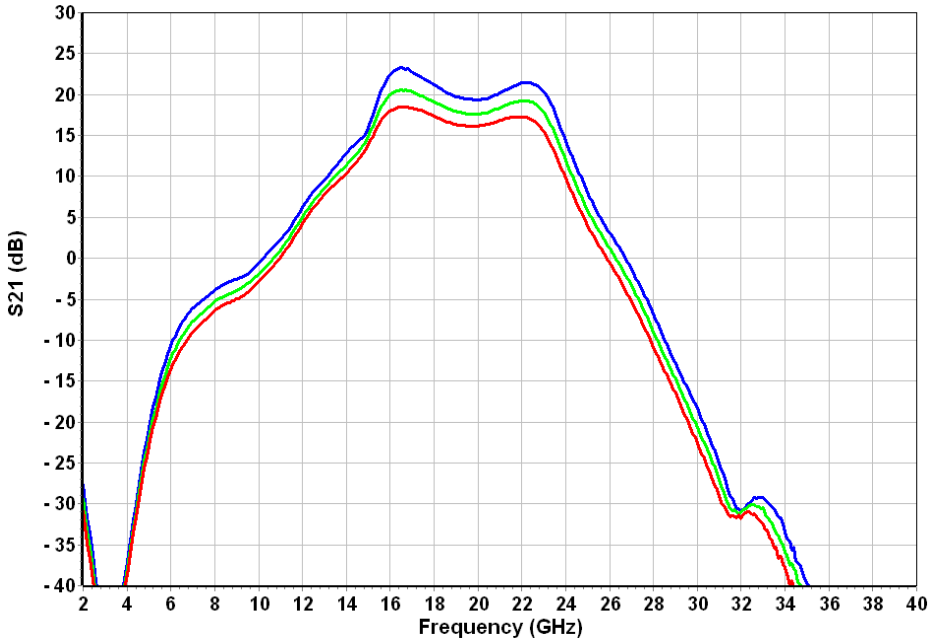
Typical Board Measurements : Small signal performance

Tcase = -40 / +25 / 85°C, Vd = 5V, Idq = 70mA (adjusted at 25°C)
Board losses are de-embedded. Measurements are given in QFN reference plans.

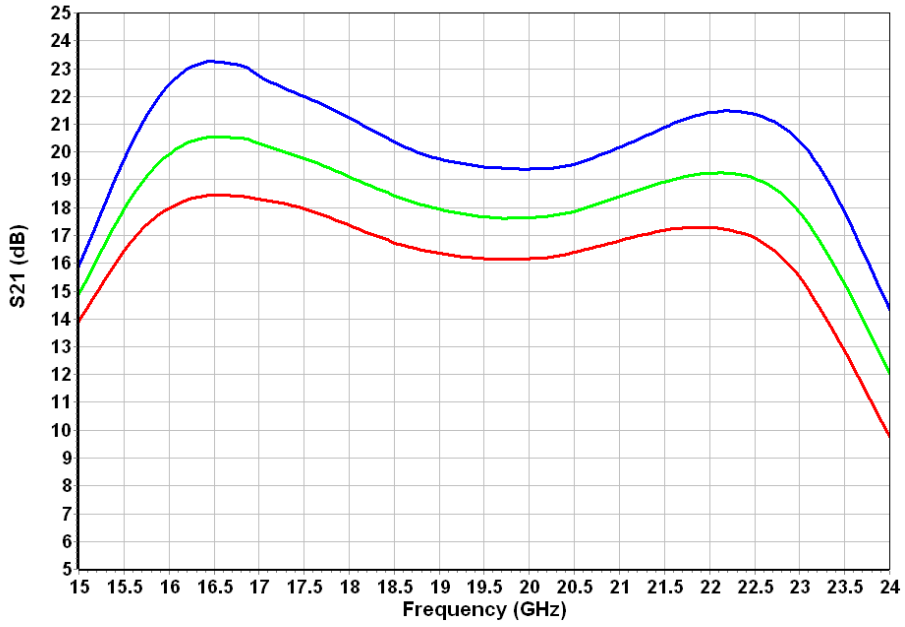
S21 vs. Frequency and temperature : wide band

Tcase: -40°C / 25°C / 85°C



S21 vs. Frequency and temperature : broadband

Tcase: -40°C / 25°C / 85°C



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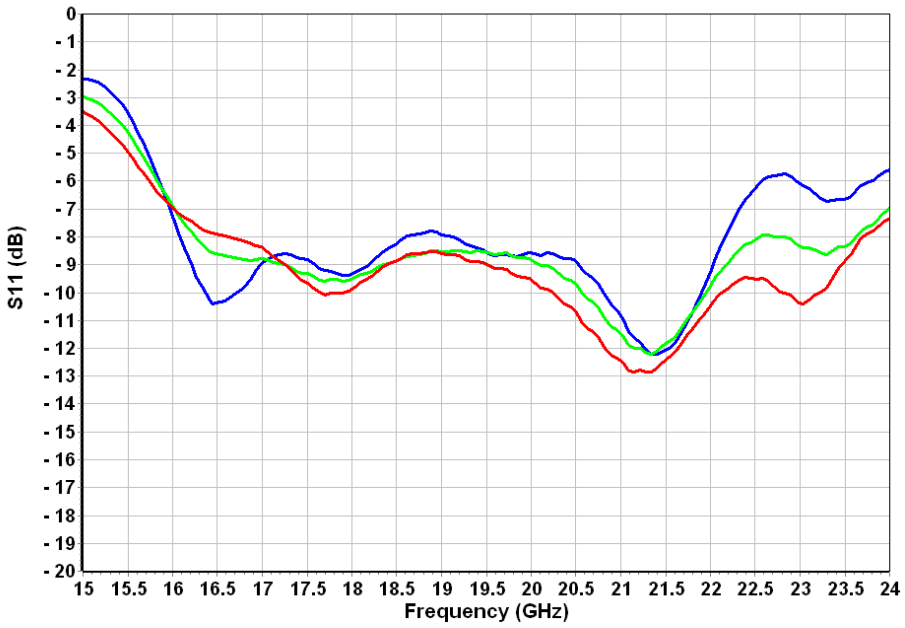
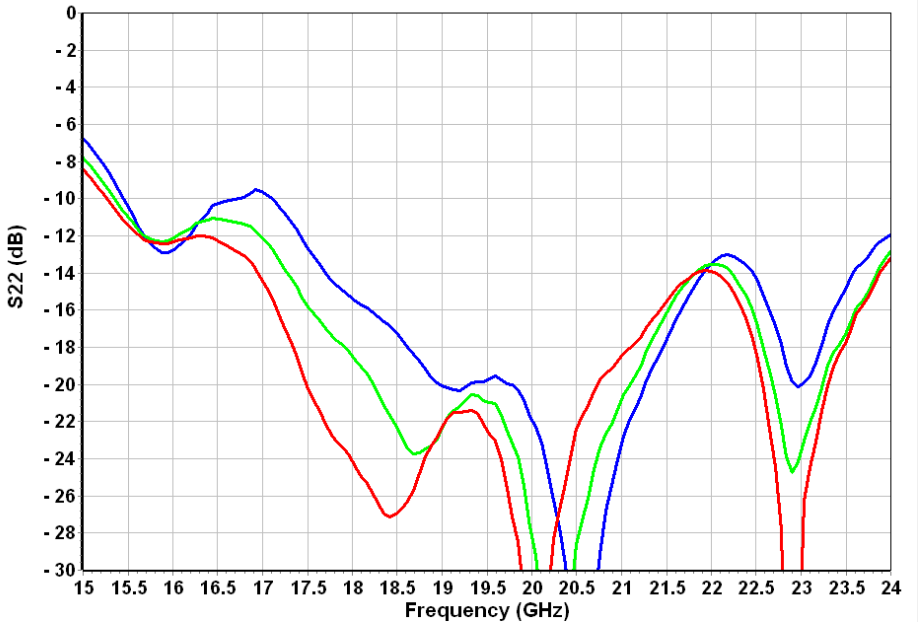
Typical Board Measurements : Small signal performance

Tcase = -40 / +25 / 85°C, Vd = 5V, Idq = 70mA (adjusted at 25°C)
Board losses are de-embedded. Measurements are given in QFN reference plans.

Input Return losses vs. Frequency and temperature
Tcase: -40°C / 25°C / 85°C



Output Return losses vs. Frequency and temperature
Tcase: -40°C / 25°C / 85°C



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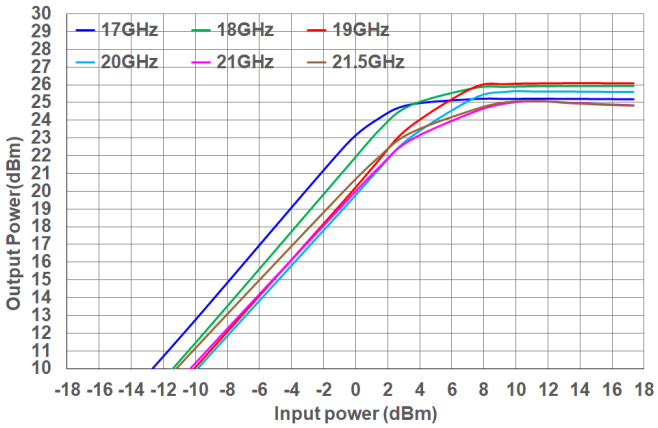
Typical Board Measurements : Large signal performance

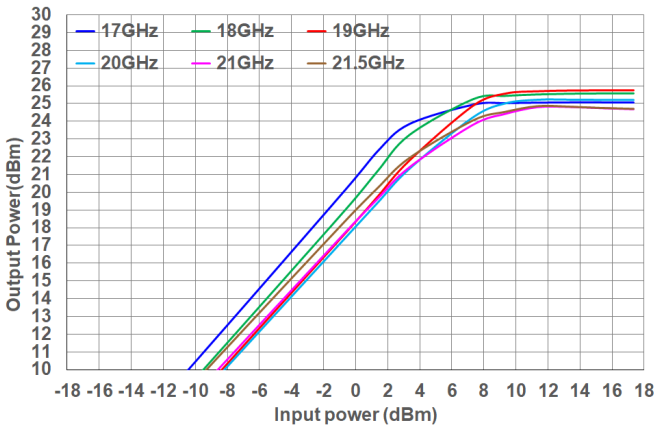
Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C
Board losses are de-embedded. Measurements are given in the package reference planes.

Output Power versus Input power

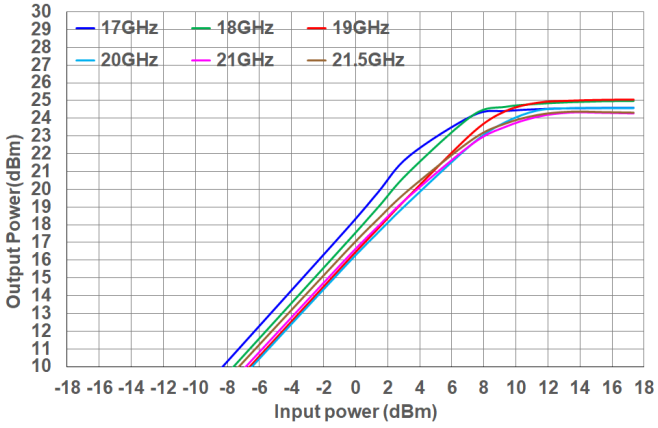
Tcase=-40°C



Tcase=25°C



Tcase=85°C



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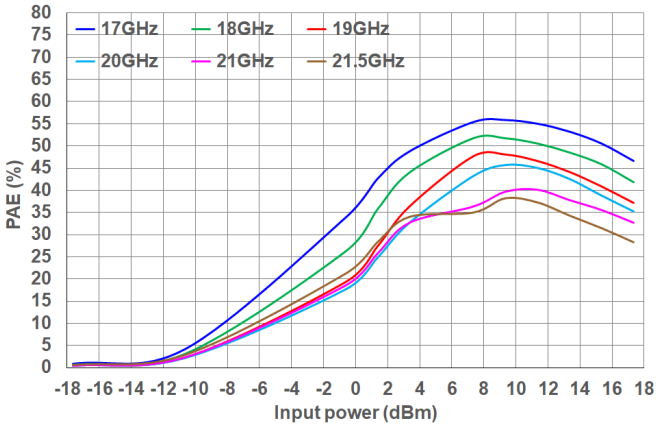
Typical Board Measurements : Large signal performance

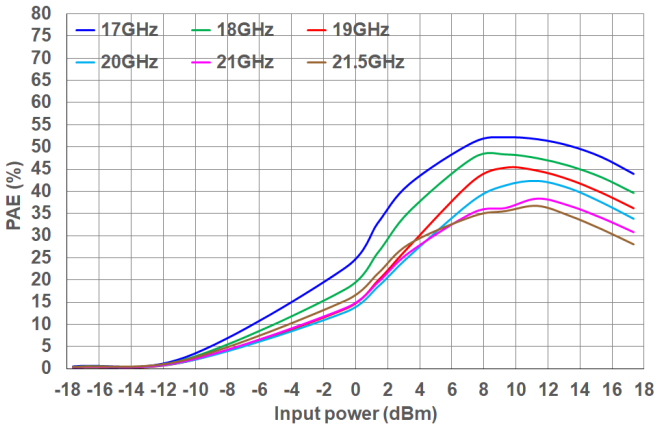
Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C
Board losses are de-embedded. Measurements are given in the package reference planes.

PAE versus Input power

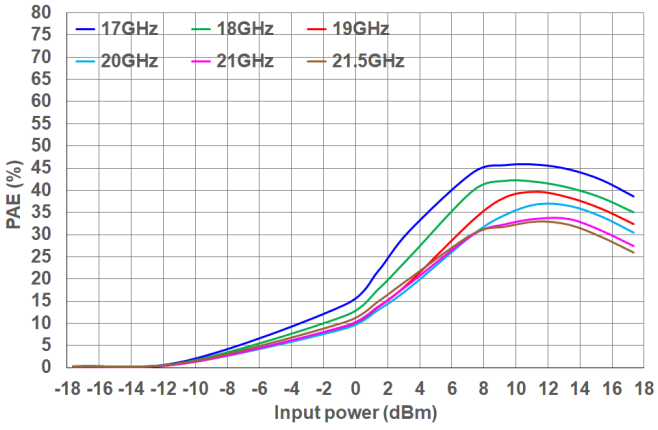
Tcase=-40°C



Tcase=25°C



Tcase=85°C



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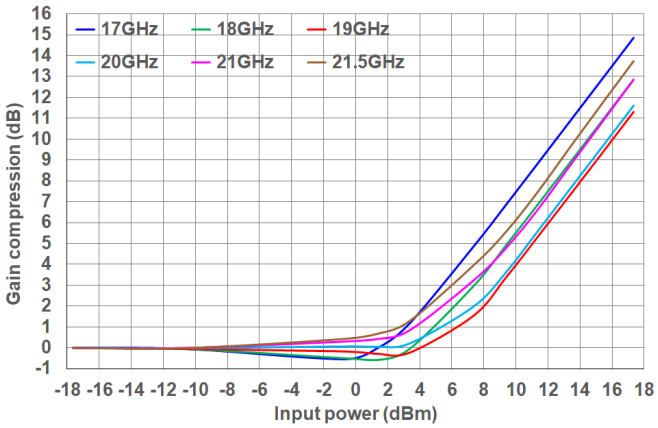
Typical Board Measurements : Large signal performance

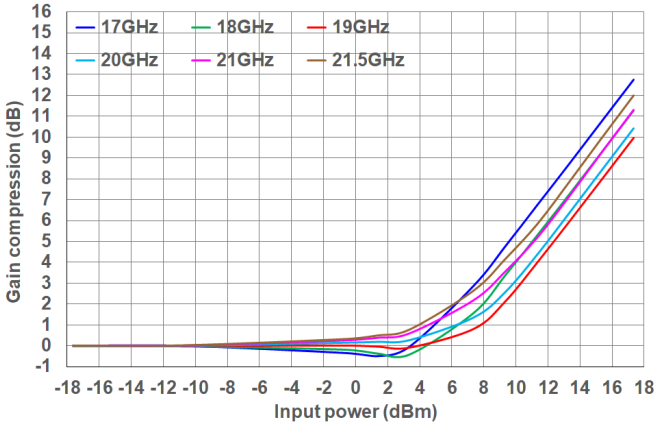
Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C
Board losses are de-embedded. Measurements are given in the package reference planes.

Gain compression versus Input power

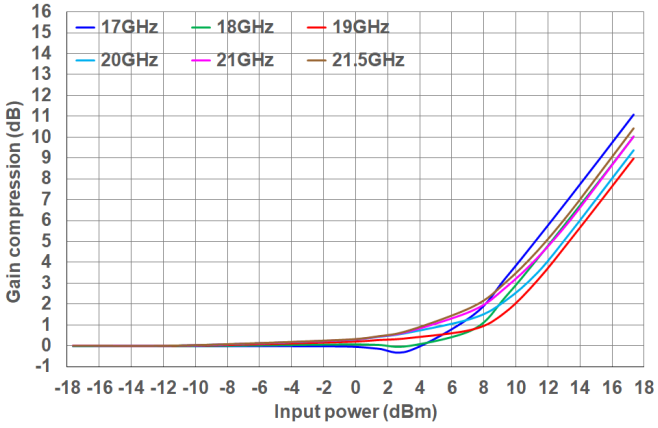
Tcase=-40°C



Tcase=25°C



Tcase=85°C



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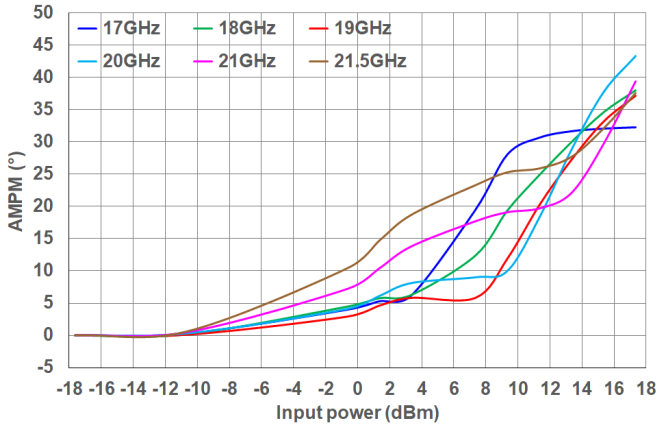
Typical Board Measurements : Large signal performance

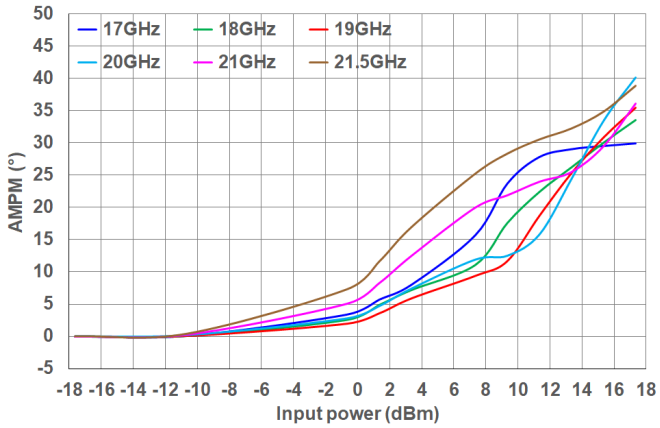
Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C
Board losses are de-embedded. Measurements are given in the package reference planes.

AMPM versus Input power

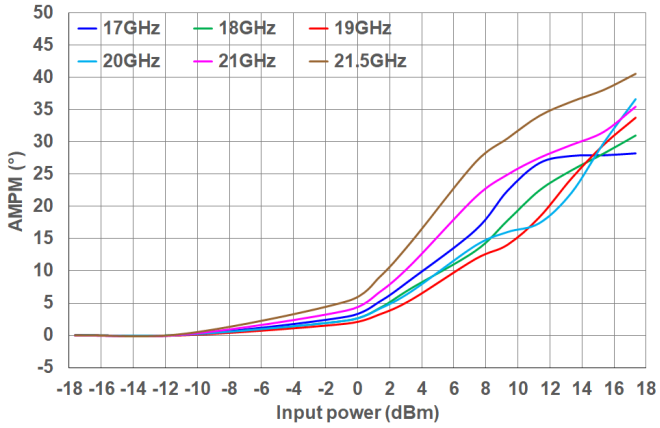
Tcase=-40°C



Tcase=25°C



Tcase=85°C



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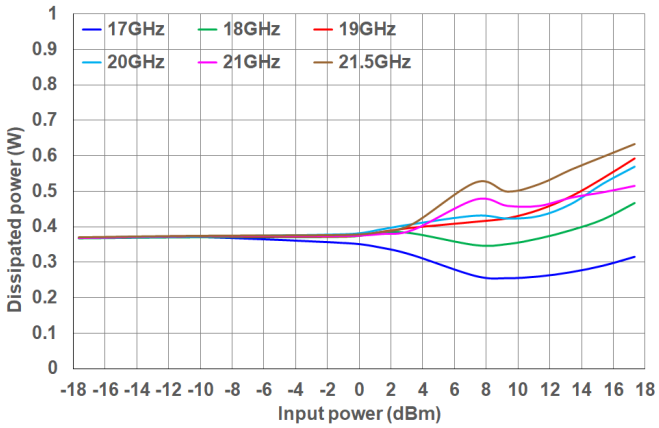
Typical Board Measurements : Large signal performance

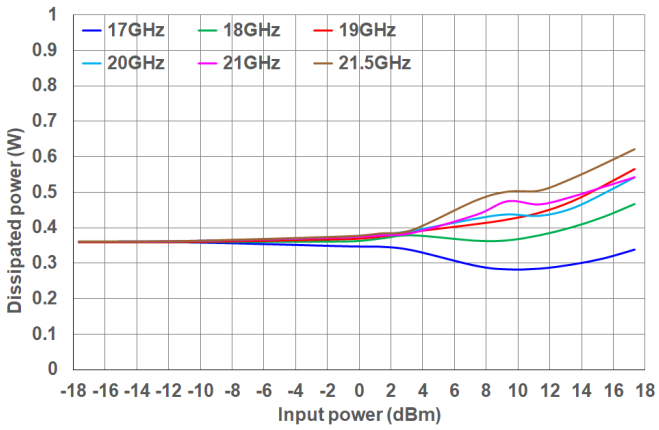
Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C
Board losses are de-embedded. Measurements are given in the package reference planes.

Dissipated power versus Input power

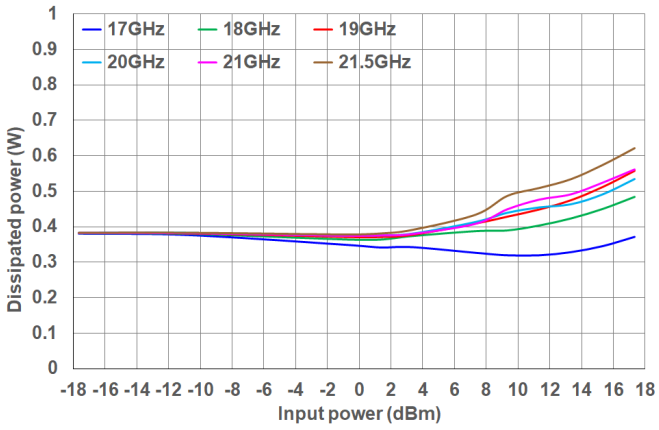
Tcase=-40°C



Tcase=25°C



Tcase=85°C



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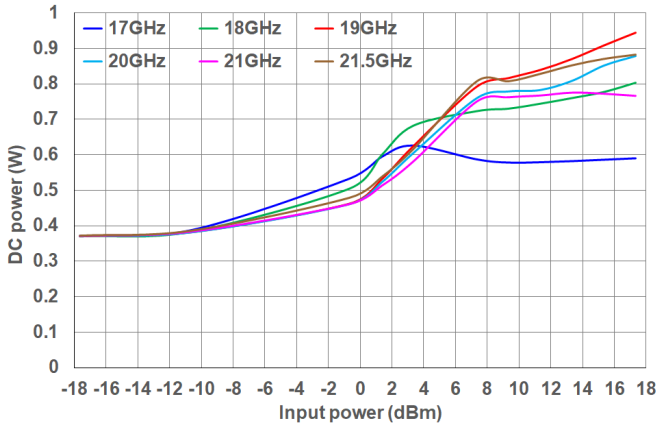
Typical Board Measurements : Large signal performance

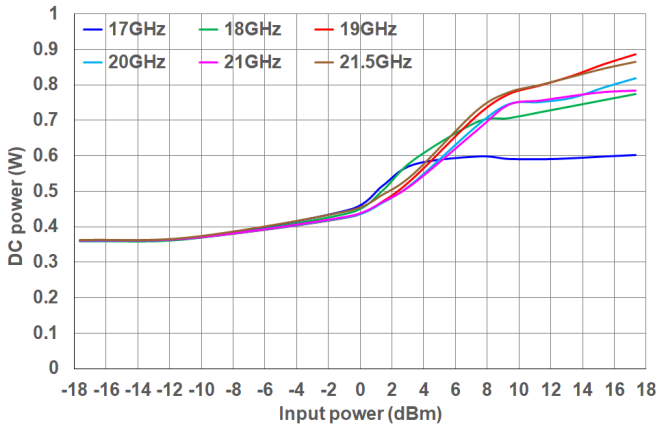
Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C
Board losses are de-embedded. Measurements are given in the package reference planes.

DC supply power versus Input power

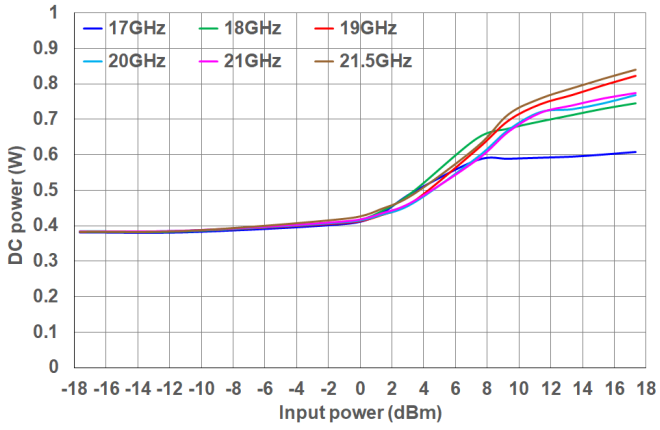
Tcase=-40°C



Tcase=25°C



Tcase=85°C



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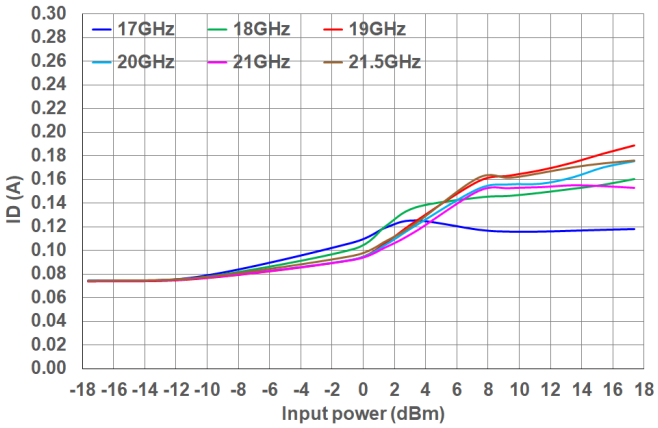
Typical Board Measurements : Large signal performance

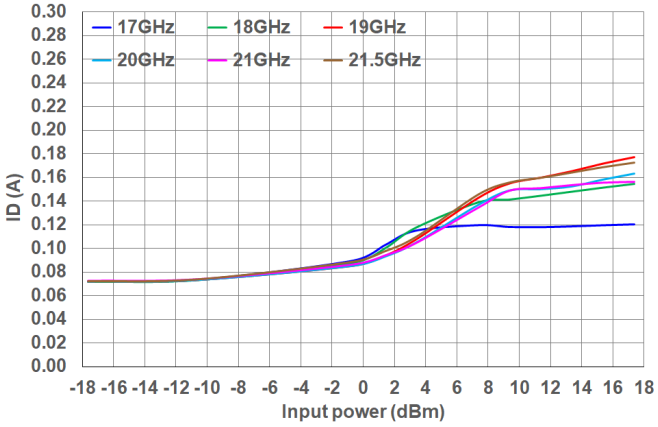
Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C
Board losses are de-embedded. Measurements are given in the package reference planes.

Drain supply current versus Input power

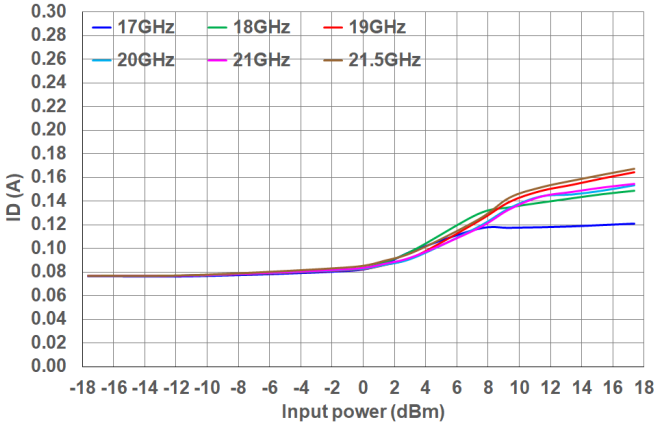
Tcase=-40°C



Tcase=25°C



Tcase=85°C



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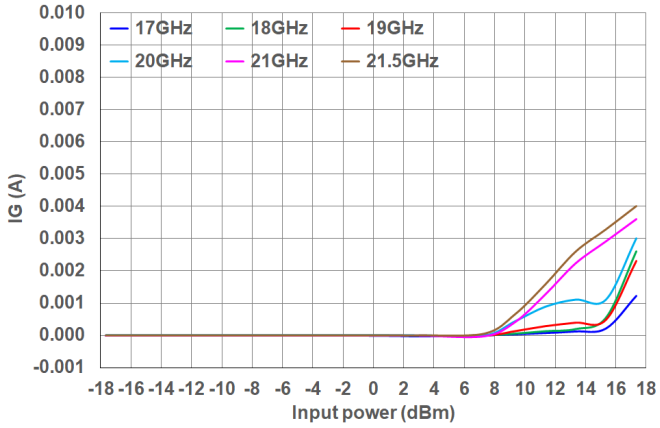
Typical Board Measurements : Large signal performance

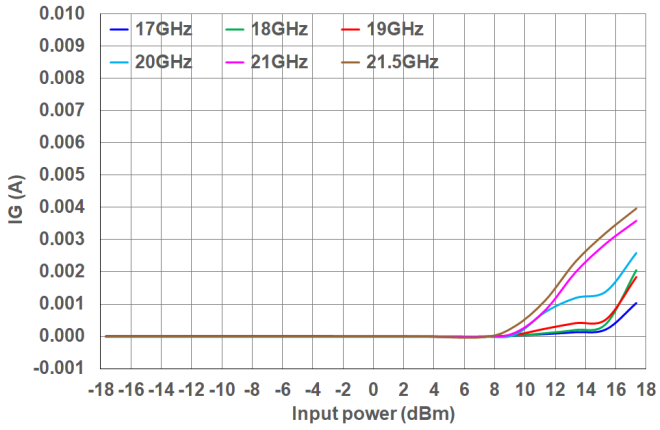
Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C
Board losses are de-embedded. Measurements are given in the package reference planes.

Gate supply current versus Input power

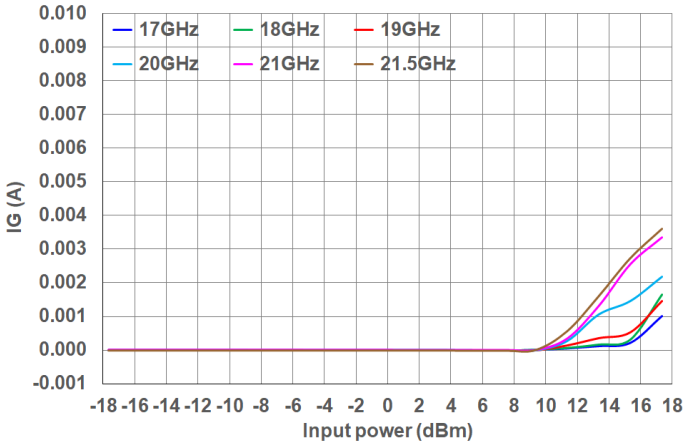
Tcase=-40°C



Tcase=25°C



Tcase=85°C



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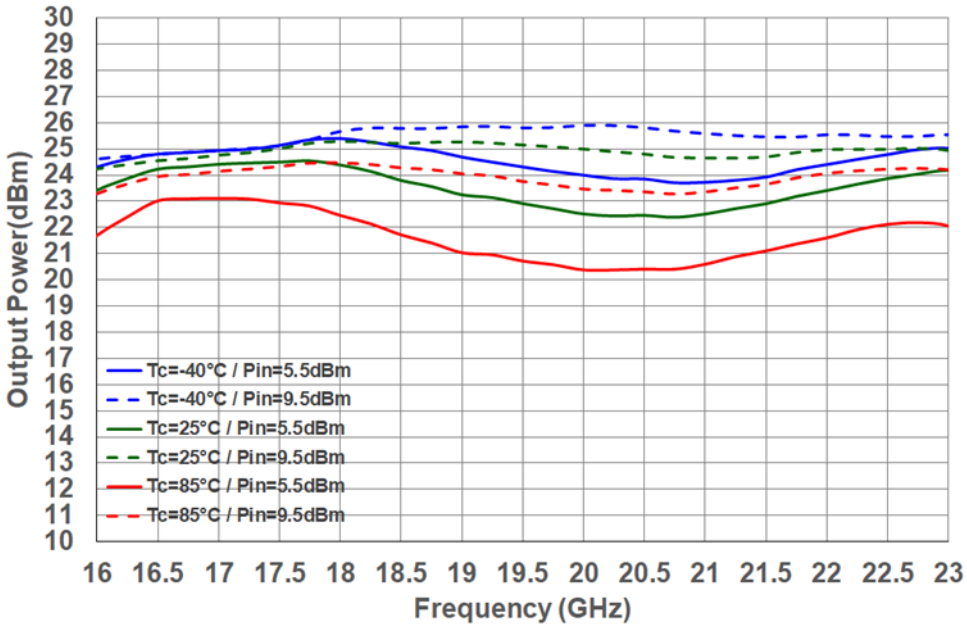
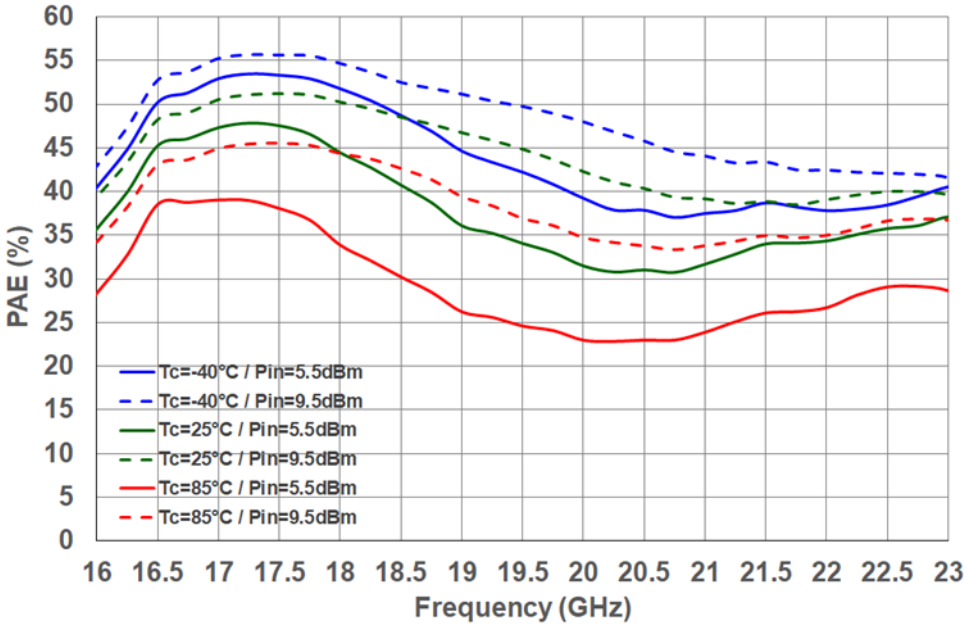
Typical Board Measurements : Large signal performance

Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C
Board losses are de-embedded. Measurements are given in the package reference planes.

Output power versus Frequency for several Input power and Temperature



PAE versus Frequency for several Input power and Temperature



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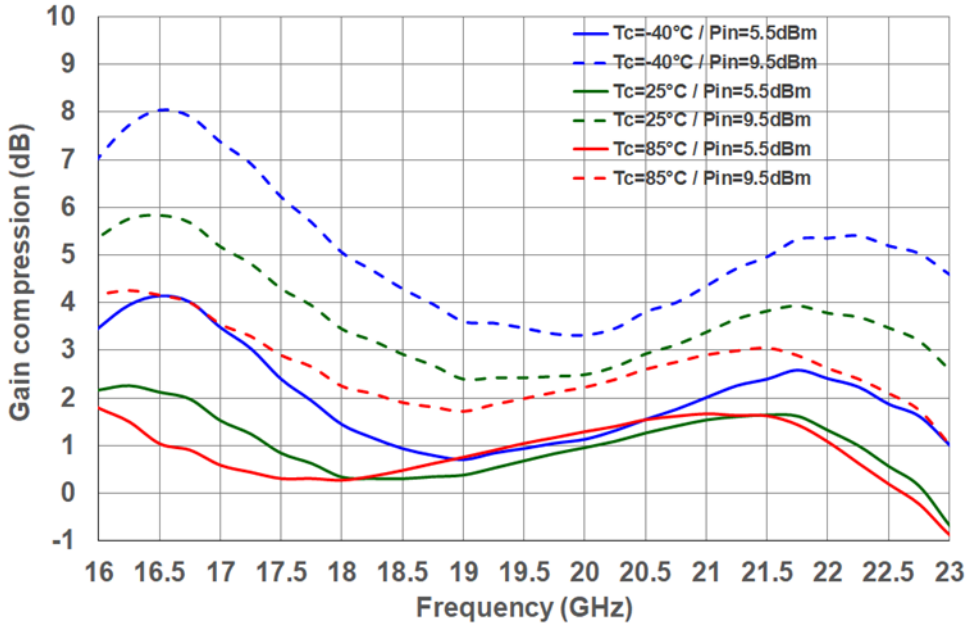
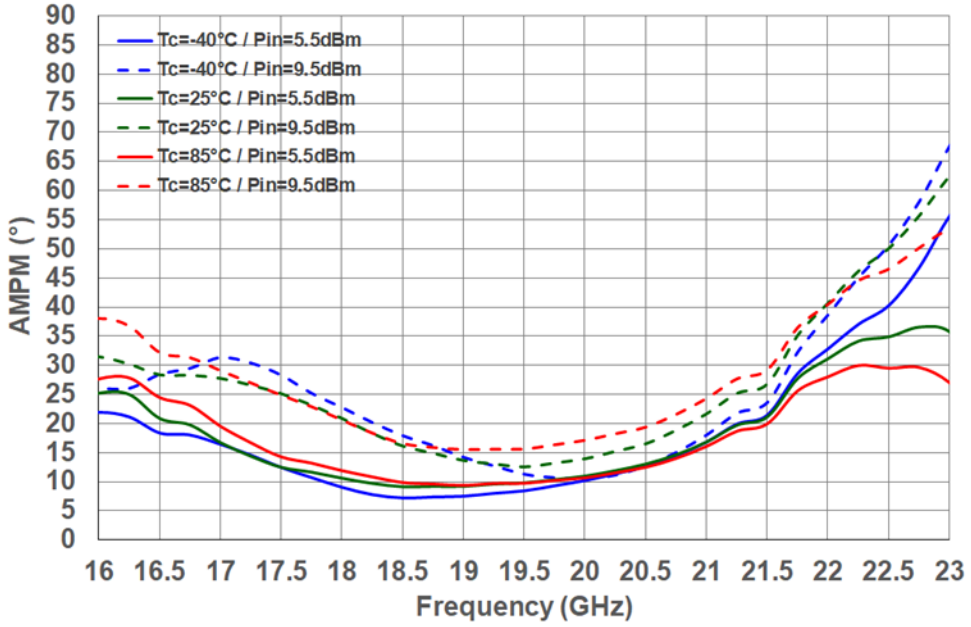
Typical Board Measurements : Large signal performance

Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C
Board losses are de-embedded. Measurements are given in the package reference planes.

Gain compression versus Frequency for several Input power and Temperature



AMPM versus Frequency for several Input power and Temperature



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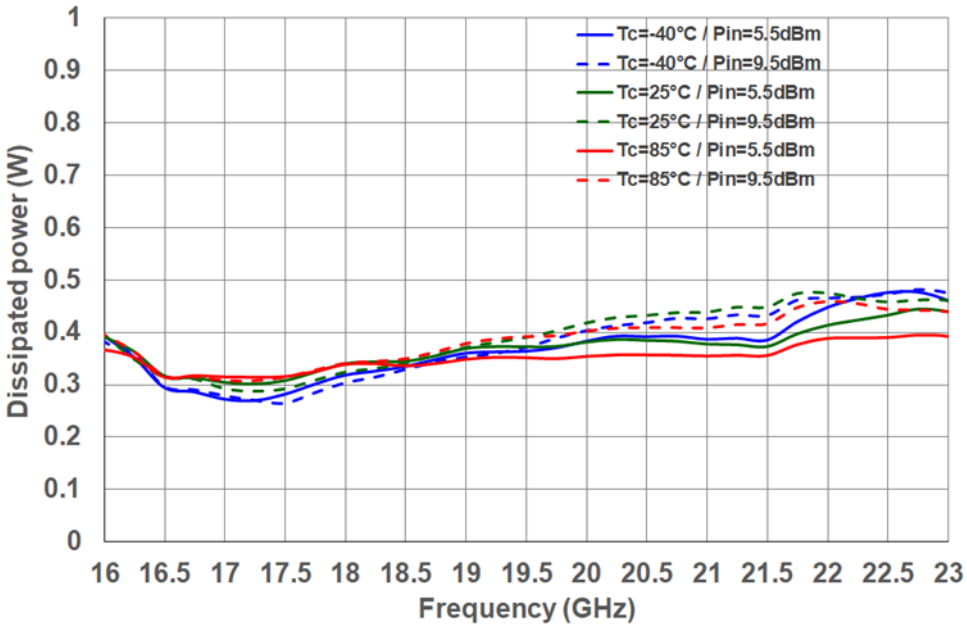
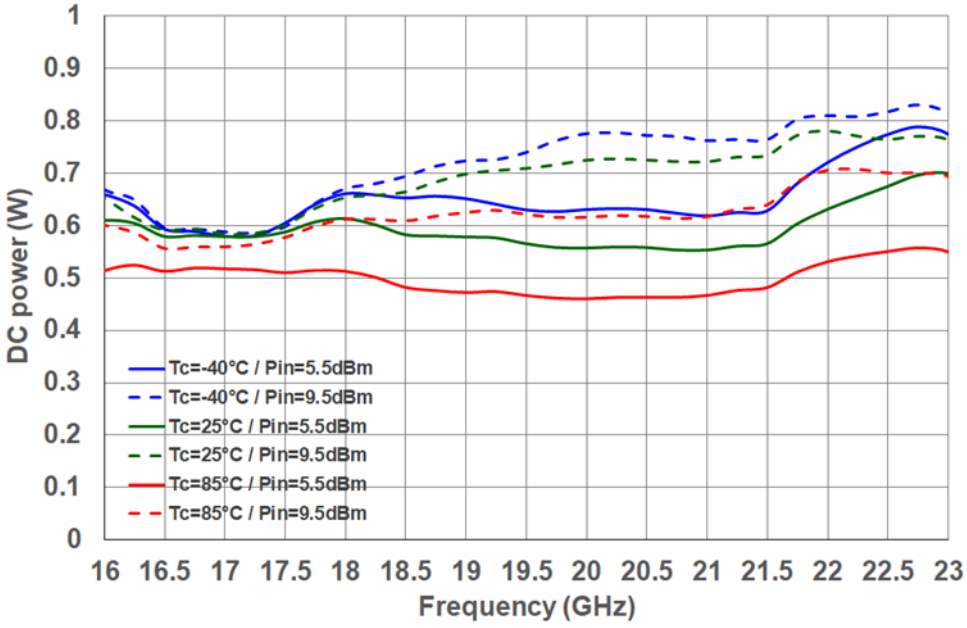
Typical Board Measurements : Large signal performance

Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C
Board losses are de-embedded. Measurements are given in the package reference planes.

Dissipated power versus Frequency for several Input power and Temperature



DC supply power versus Frequency for several Input power and Temperature



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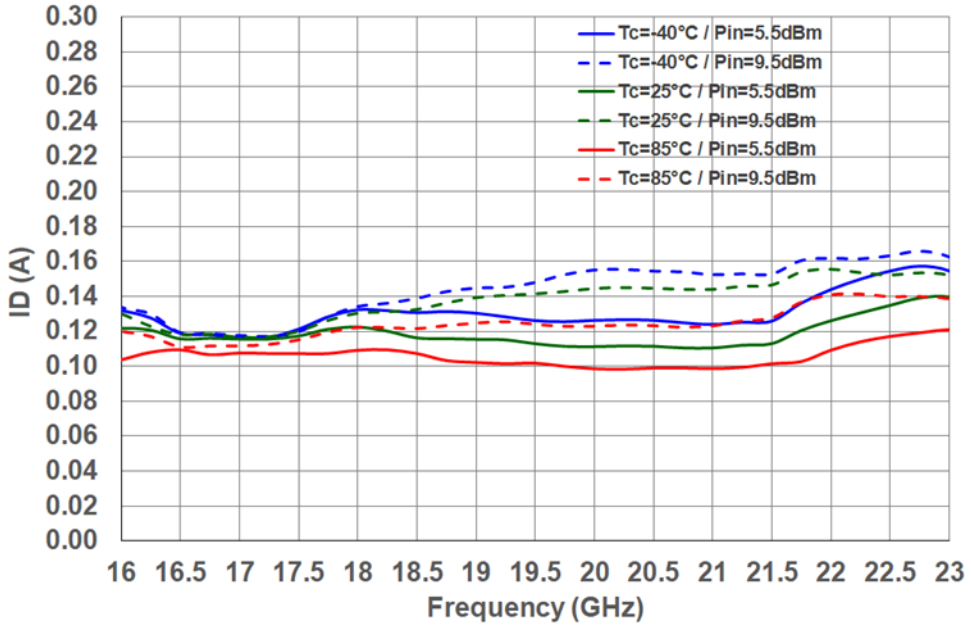
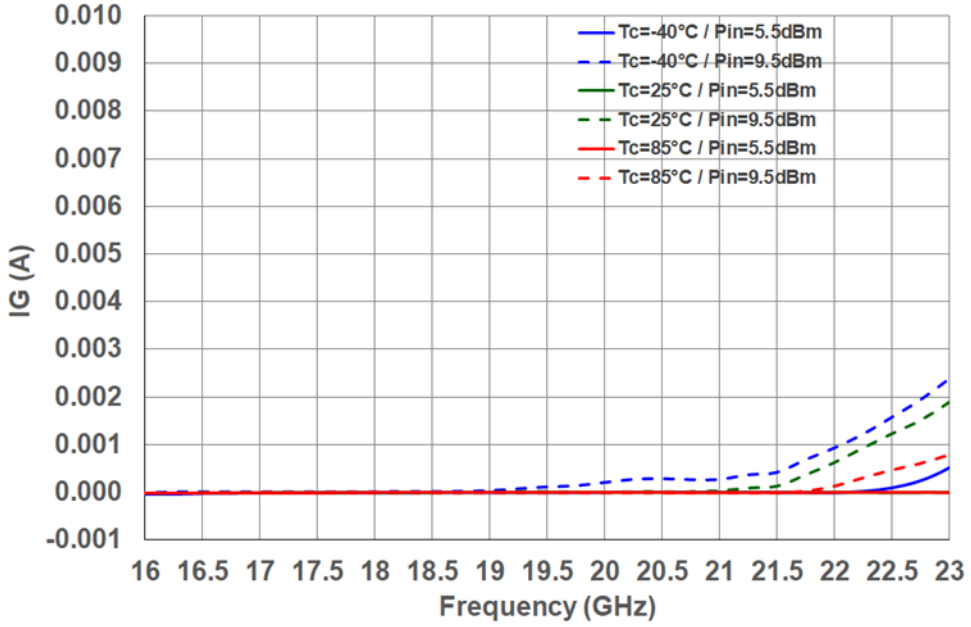
Typical Board Measurements : Large signal performance

Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C
Board losses are de-embedded. Measurements are given in the package reference planes.

Drain supply current versus Frequency for several Input power and Temperature



Gate supply current versus Frequency for several Input power and Temperature



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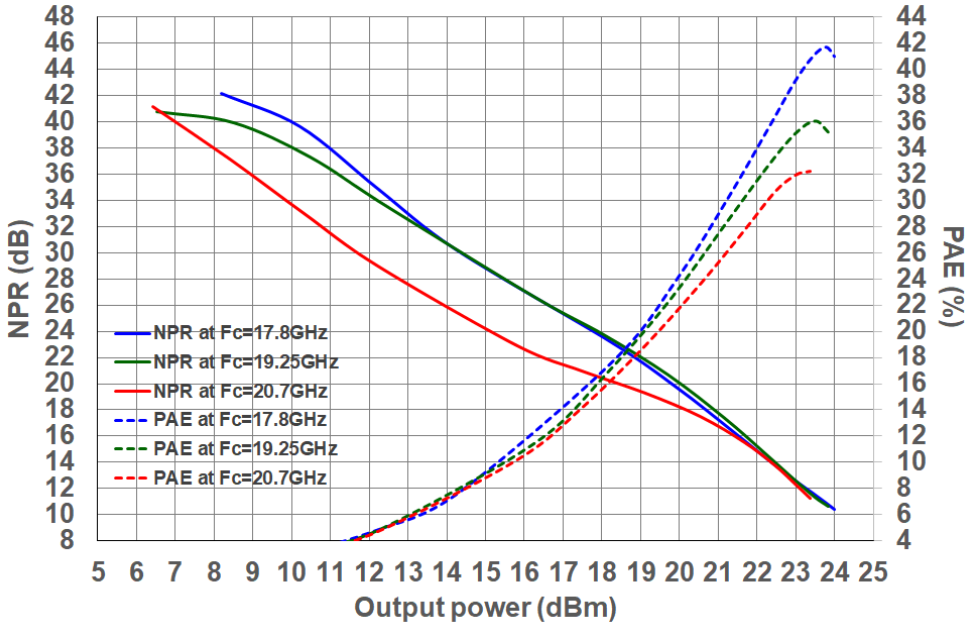
Typical Board Measurements : Noise Power Ratio

NPR Signal : 1GHz Signal Banwidth, 10% Notch

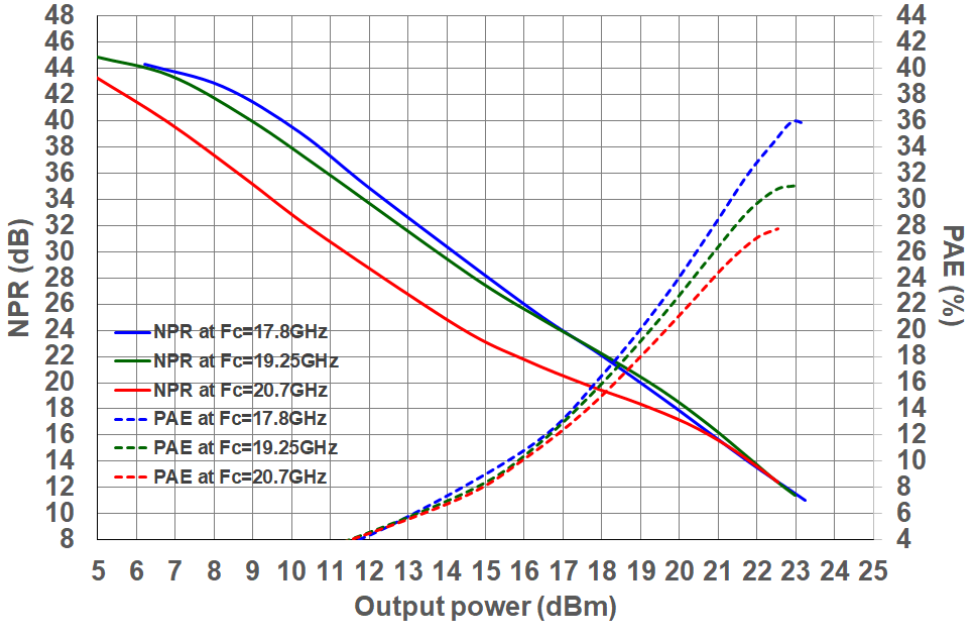
Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C
Board losses are de-embedded. Measurements are given in the package reference planes.

NPR and PAE versus Output Power and Central Frequency

Tcase=25°C



Tcase=85°C



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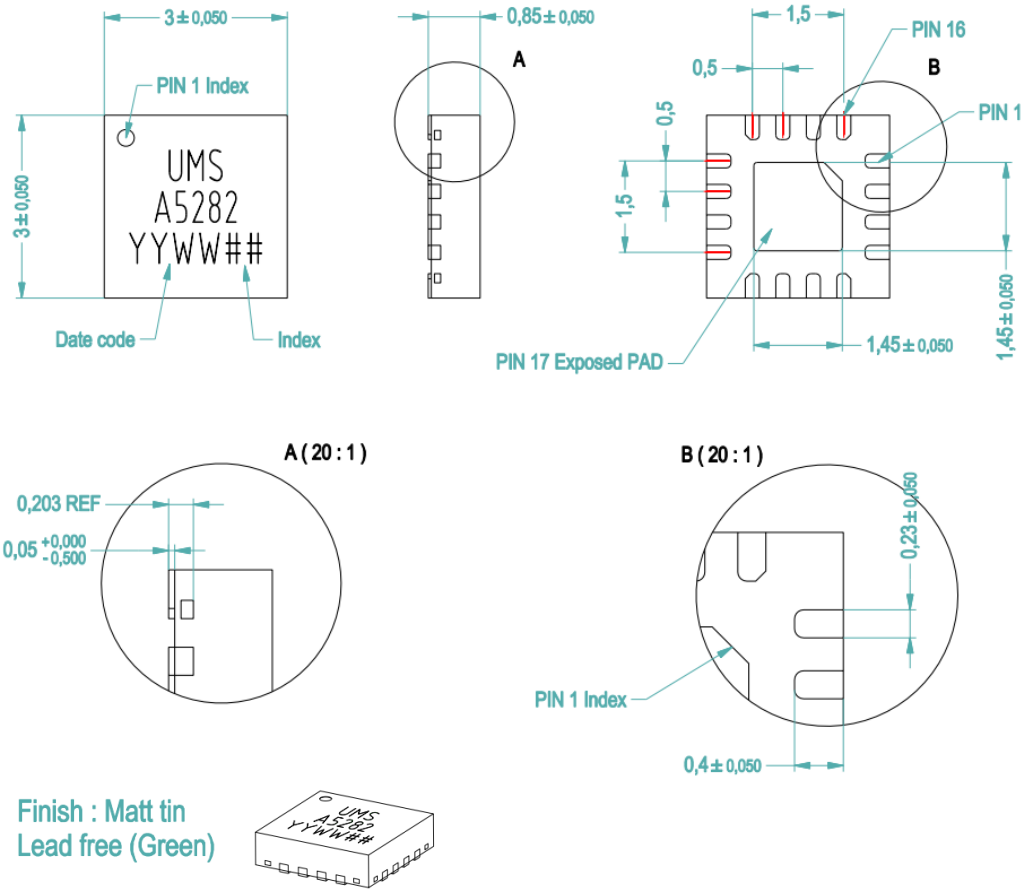
Package outline (1)



Units :	mm	1- GND(2)	8- GND(2)	15- GND(2)
Finish :	Matt tin	2- GND(2)	9- GND(2)	16- VD1
MSL Rating :	MSL1	3- RFin	10- RFout	17- GND(2)
Lead Free (Green)		4- GND(2)	11- GND(2)	
From the standard :	JEDEC MO-220	5- VG1	12- GND(2)	
		6- GND(2)	13- GND(2)	
NC :	Not Connected	7- VG2	14- VD2	

(1) Refer to the application note AN0017 (https://www.ums-rf.com) for general consideration and recommendations for Molded Plastic QFN/DFN packages.

(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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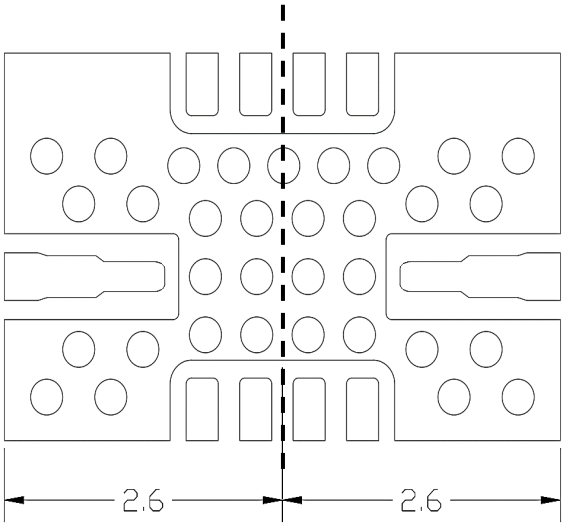
Definition of measurements reference planes

The reference planes used measurements given above are symmetrical from the symmetrical axis of the package (see drawing beside). The input and output reference planes are located at 2.6mm offset (input wise and output wise respectively) from this axis.



Package Information

Parameter	Value
Package body material	RoHS-compliant
	Low stress Injection Molded Plastic
Lead finish	Matt tin
MSL Rating	MSL1

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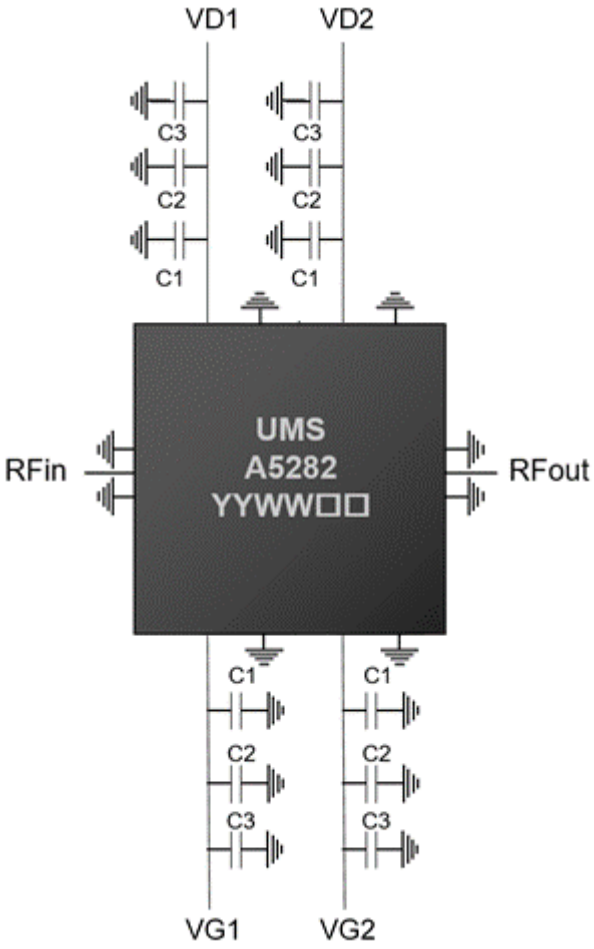
Recommended Assembly Plan



Bill of Materials

Label	Value	Description
C1	RF	Capacitor 120pF ±15%
C2	RF	Capacitor 10nF ±10%
C3	RF	Capacitor 1µF ±10%

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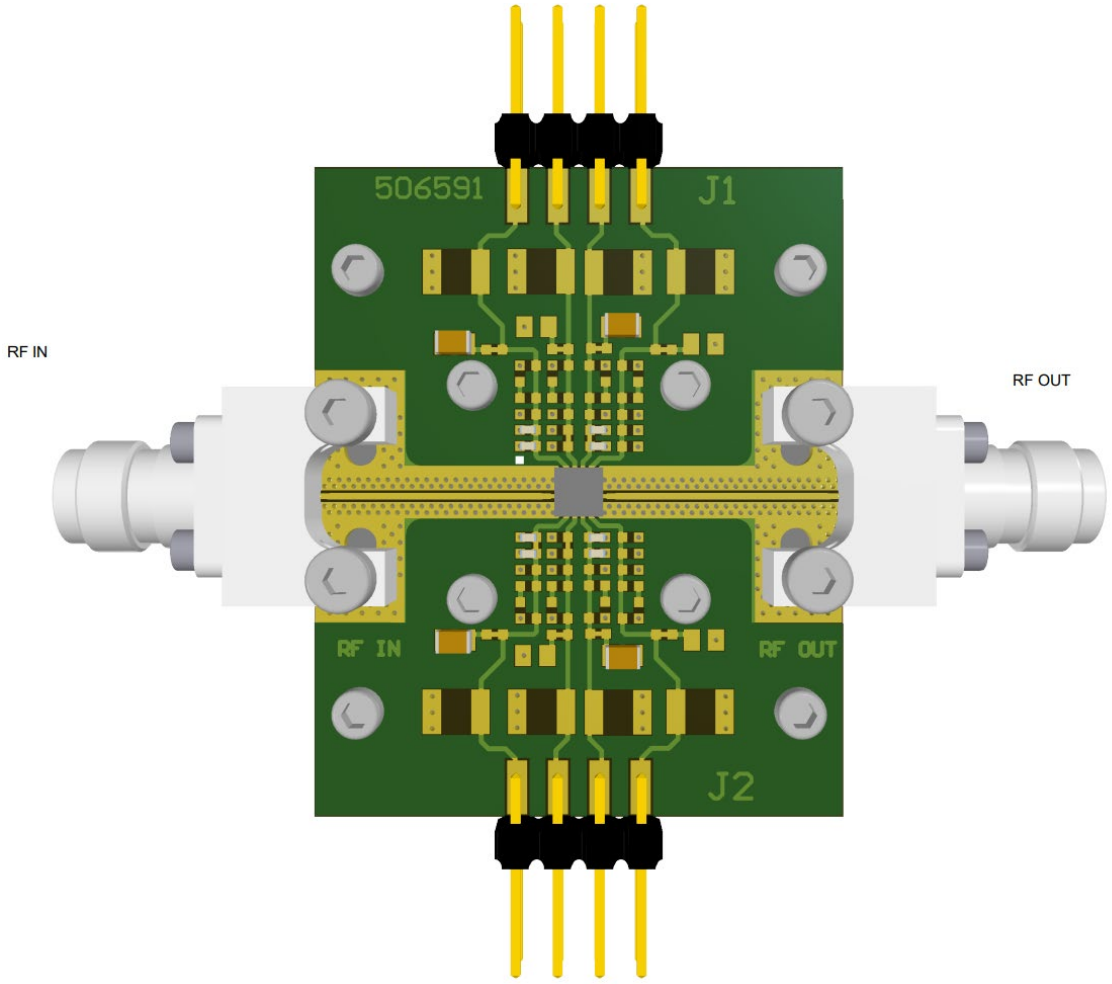
Evaluation Board

- Compatible with the proposed footprint.
- Based on typically Ro4350 / 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 120pF, 10nF, 1µF ±10% are recommended for all DC accesses.
- See application note AN0017 for details.



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

Refer to the application note AN0031 available at http://www.ums-rf.com for the description of Evaluation Board for Packaged Die and recommendations for this UMS package.

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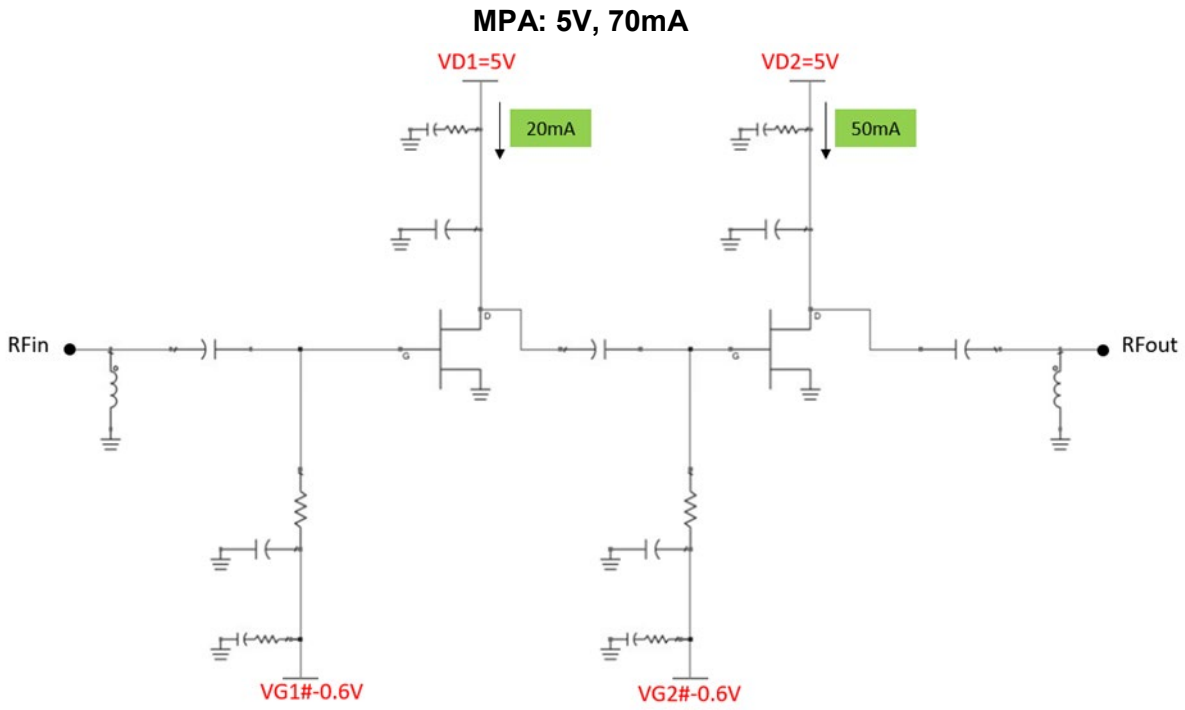
DC Schematic



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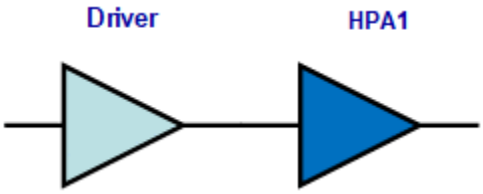
Recommended UMS Power chain

The CHA5282-QAG is recommended with the following HPAs:

CHA6161-QKB, CHA6251-QKB

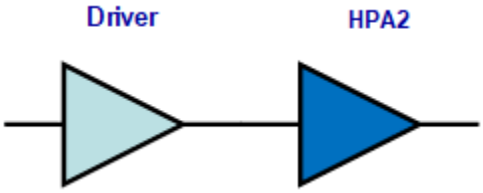
For more information about CHA6161-QKB and CHA6251-QKB, see our web site:

https://www.ums-rf.com



CHA5282-QAG
17- 21.5GHz
5V
70mA

CHA6161-QKB
17- 21.5GHz
14V
60mA



CHA5282-QAG
17- 21.5GHz
5V
70mA

CHA6251-QKB
17- 21.5GHz
14V
125mA

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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.

Description of Evaluation Board

Refer to the application note AN0031 available at https://www.ums-rf.com for the description of Evaluation Board for Packaged Die and recommendations for this UMS package product.

Ordering Information

Evaluation Board:	EDG-CHA5282-QAG	
QFN 3x3 package:	CHA5282-QAG/XY	
	Stick: XY = 20	Tape & reel: XY = 21

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