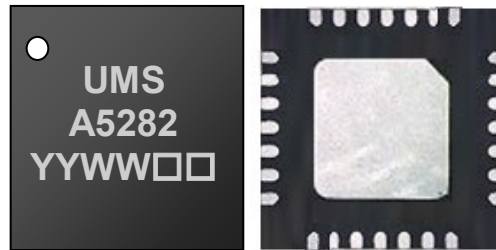


Advanced Information: AI2414

17-21.5GHz Medium Power Amplifier

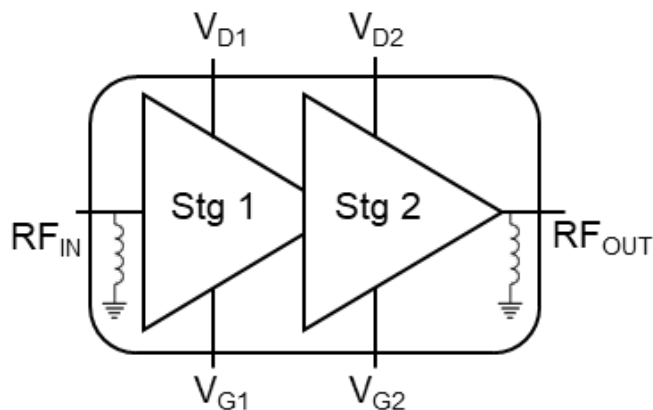
GaAs Monolithic Microwave IC



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.

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



Electrical Characteristics

$T_{case} = 25^{\circ}C$, $V_d = 5V$, $I_{dq}=70mA$ 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		23.5		dBm
P_{sat}	Output Power at 3dBc		25		dBm
PAE	Power Added Efficiency at 3dBc		44		%
AMPM	Phase shift at 3dBc		16		°
NPR	NPR at Pout=23dBm		15		dB
I_{dq}	Quiescent Current		70		mA

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

“Power ON” sequence

1. Ground the device
2. Set the Gate voltage to -1.5V
3. Apply the Drain voltage V_d (Typically 5V)
4. Increase V_g up to quiescent bias drain current I_{dq}
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 V_d supply
5. Turn off V_g supply

Advanced Information

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.

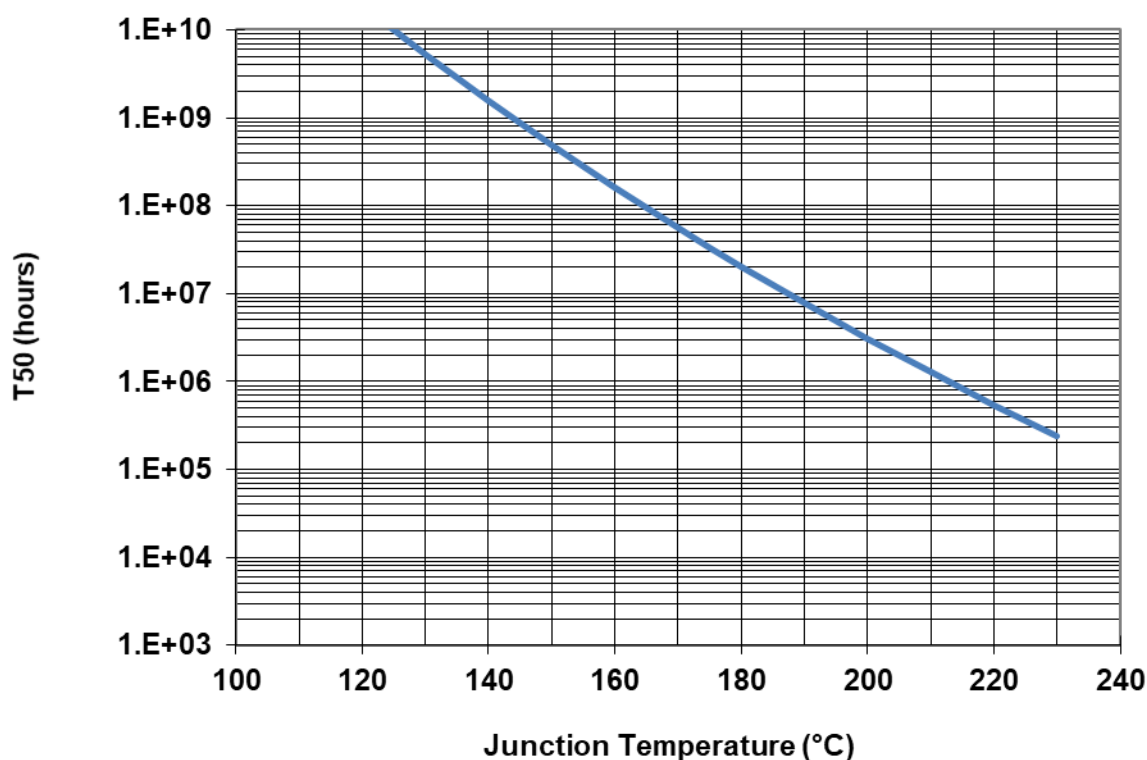
The temperature is monitored at the QFN back-side interface (T_{case}).

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)
$R_{\text{TH}}^{(1)}$ Thermal Resistance (Junction to Case)	Vd= 5V Pout= 25dBm Pdis= 0.47W	148	135	2.85e9
	Vd= 5V Idq=75mA noRF Pdis= 0.375W	135	133	3.64e9

⁽¹⁾ Assuming 85°C T_{case}



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Absolute Maximum Ratings ⁽¹⁾ $T_{case} = 25^{\circ}\text{C}$

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	8	V
Idq	Quiescent Drain current	150	mA
Vg	Gate bias voltage	-2.5	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	5	V
Idq	Quiescent Drain current	70	mA
Pin	Maximum peak input power overdrive ⁽²⁾	15	dBm
T_{case}	Operating temperature range	-40 to 85	$^{\circ}\text{C}$
T_{stg}	Storage temperature range	-55 to 150	$^{\circ}\text{C}$

⁽²⁾ Electrical performances are defined for specified test conditions⁽³⁾ Electrical performances are not guaranteed over all recommended operating conditions**Advanced Information**

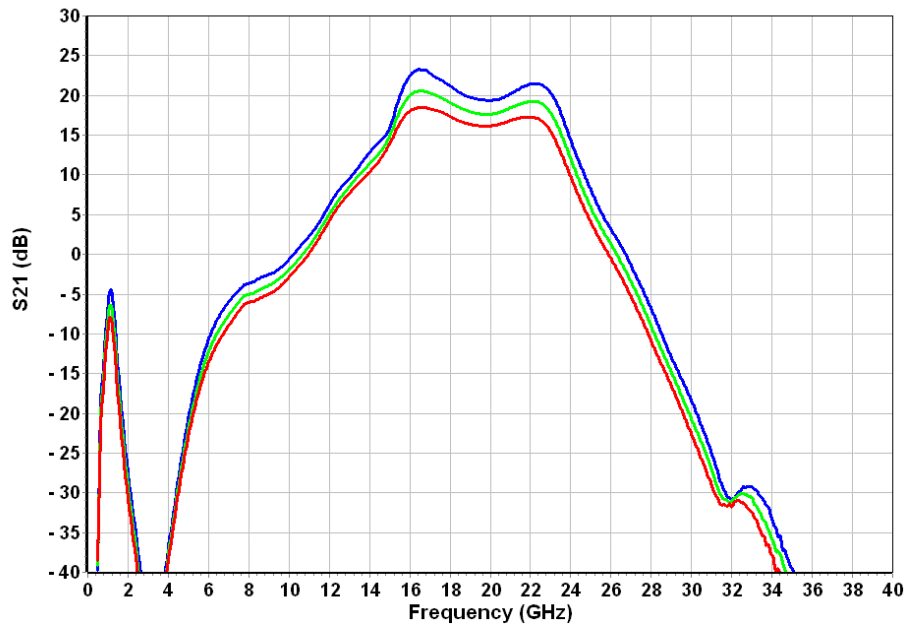
Typical Board Measurements : Small signal performance

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.

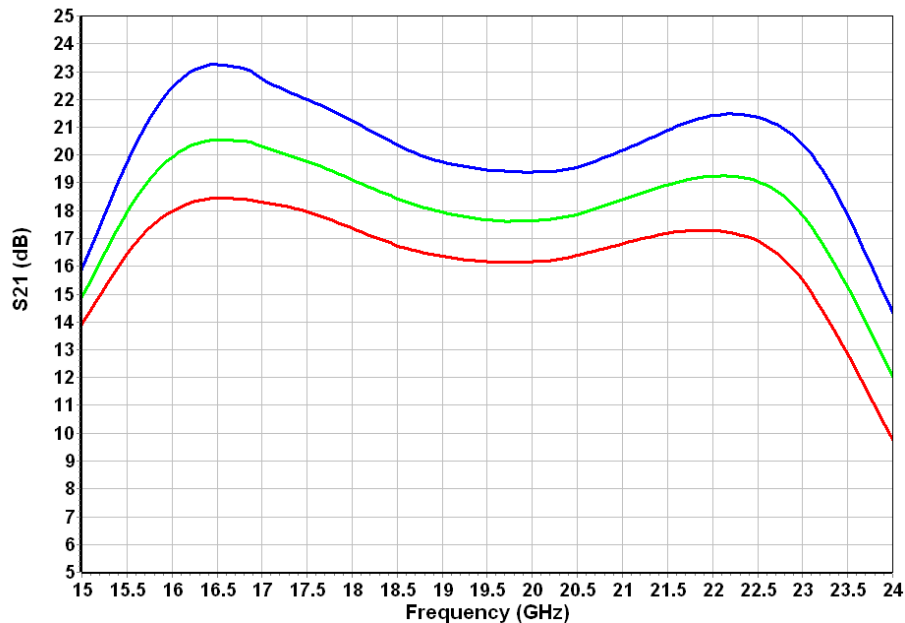
Small signal Gain vs. Frequency and temperature

Tcase: -40°C / 25°C / 85°C



Noise Figure vs. Frequency and temperature

Tcase: -40°C / 25°C / 85°C



Advanced Information

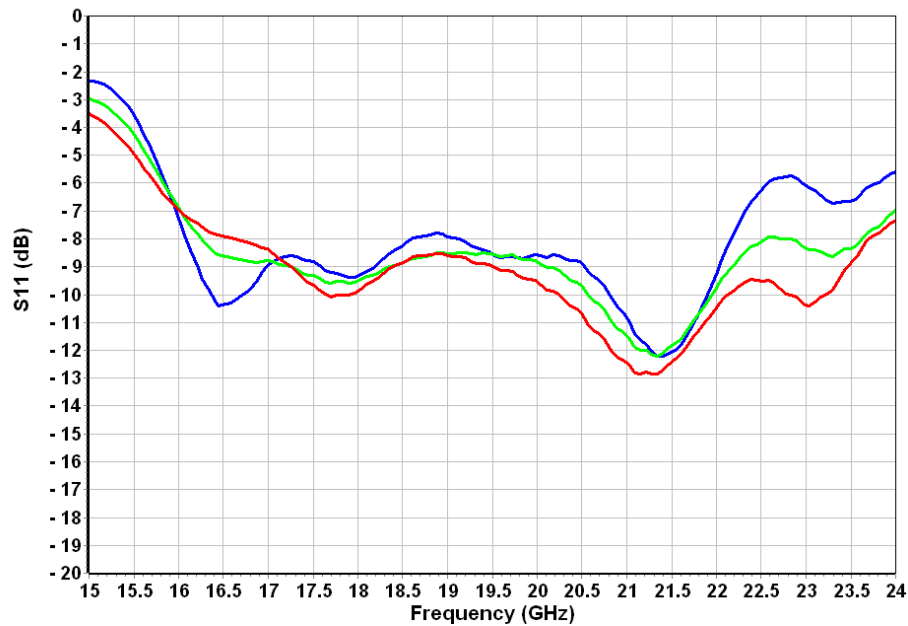
Typical Board Measurements : Small signal performance

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.

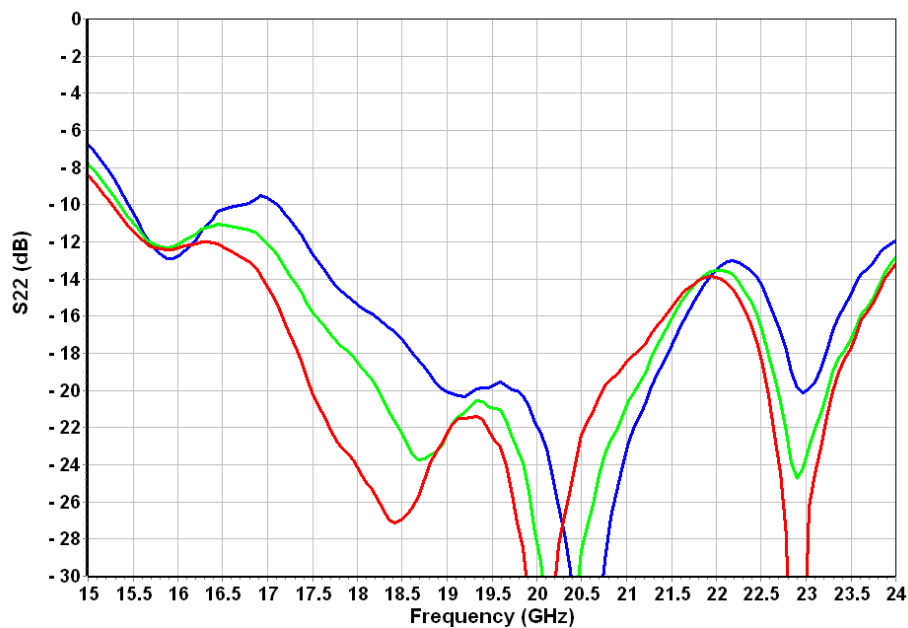
Input Return losses vs. Frequency and temperature

Tcase: -40°C / 25°C / 85°C



Output Return losses vs. Frequency and temperature

Tcase: -40°C / 25°C / 85°C



Advanced Information

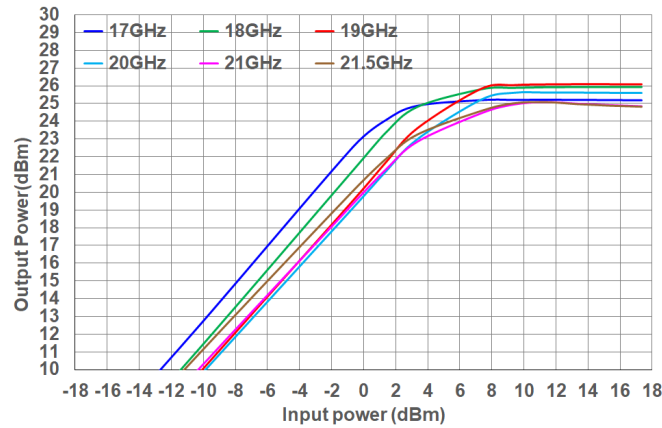
Typical Board Measurements : Large signal performance

Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C

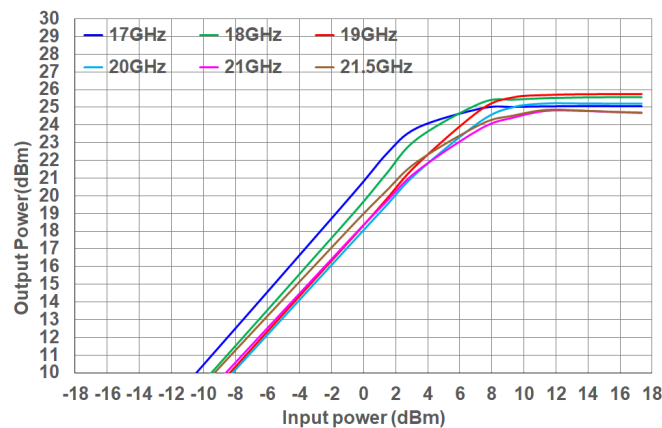
Board losses are de-embedded. Measurements are given in the package reference planes.

Output Power versus Input power

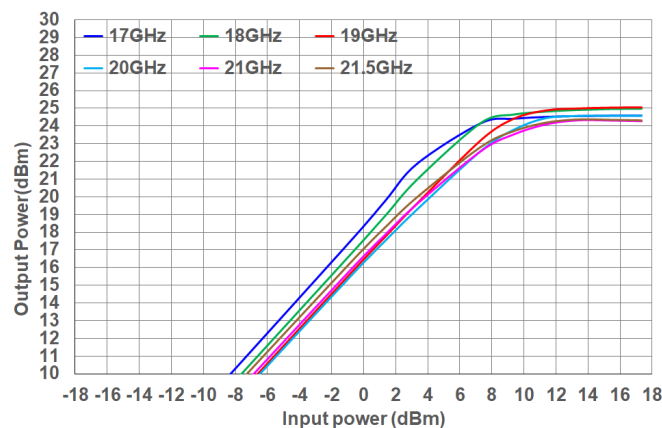
Tcase=-40°C



Tcase=25°C



Tcase=85°C



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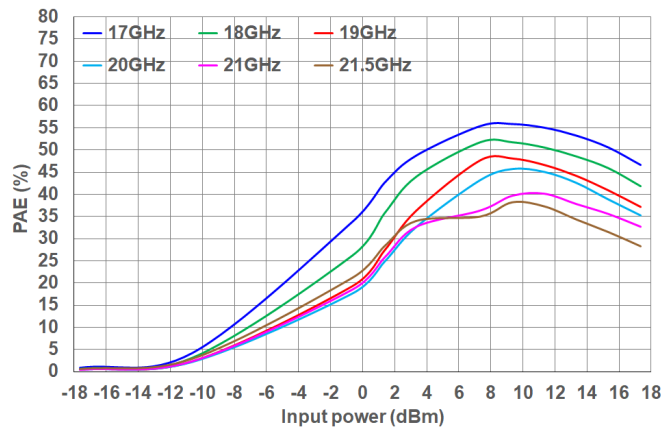
Typical Board Measurements : Large signal performance

Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C

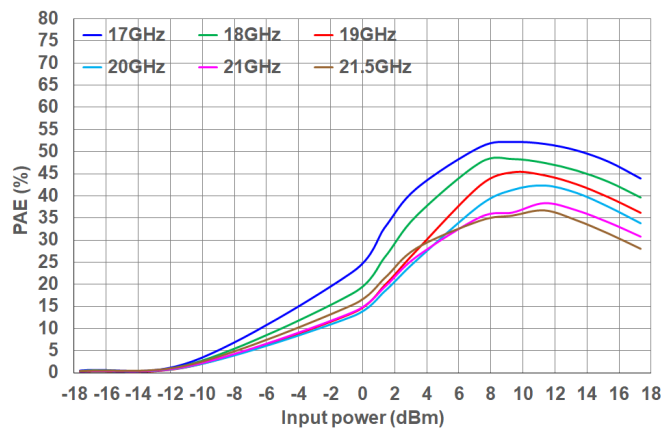
Board losses are de-embedded. Measurements are given in the package reference planes.

PAE versus Input power

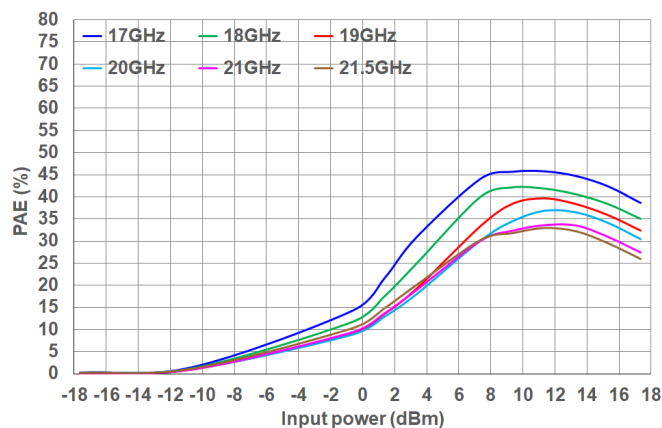
Tcase=-40°C



Tcase=25°C



Tcase=85°C



Advanced Information

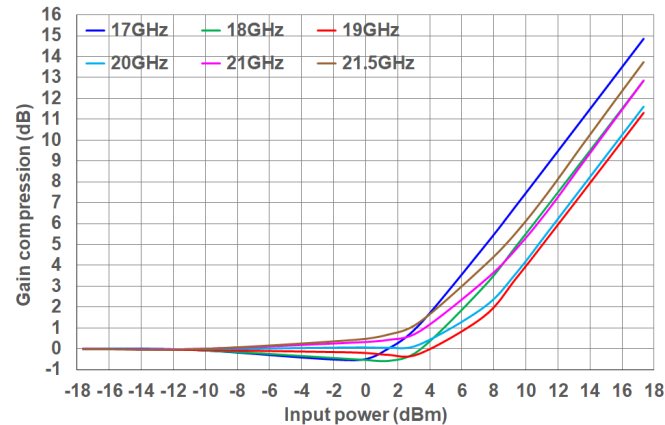
Typical Board Measurements : Large signal performance

Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C

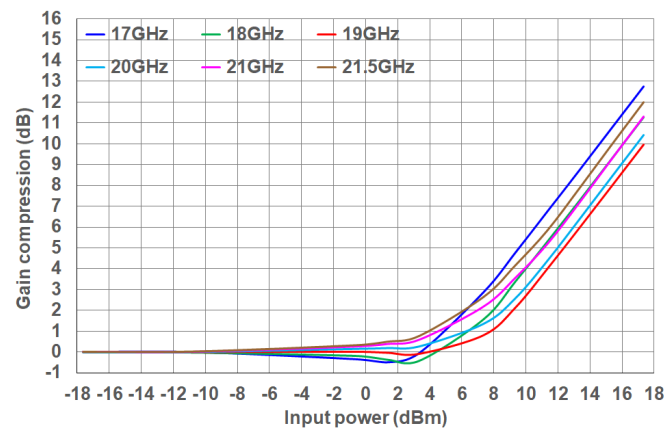
Board losses are de-embedded. Measurements are given in the package reference planes.

Gain compression versus Input power

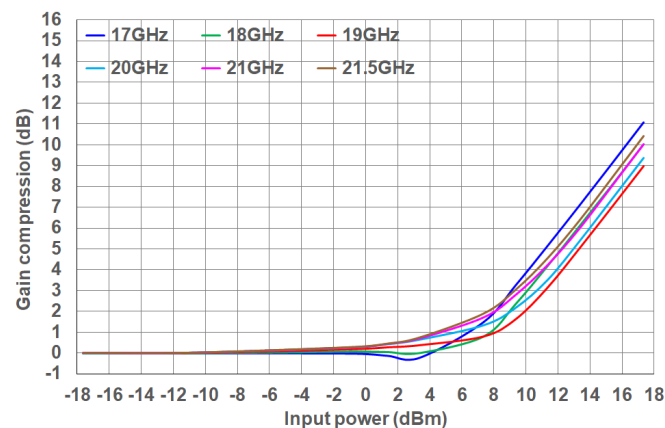
Tcase=-40°C



Tcase=25°C



Tcase=85°C



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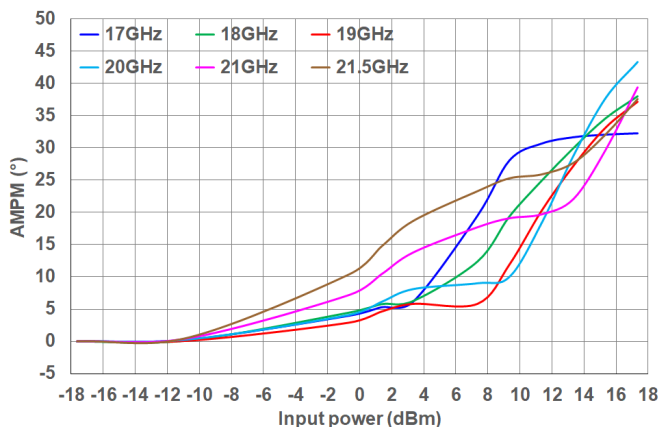
Typical Board Measurements : Large signal performance

Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C

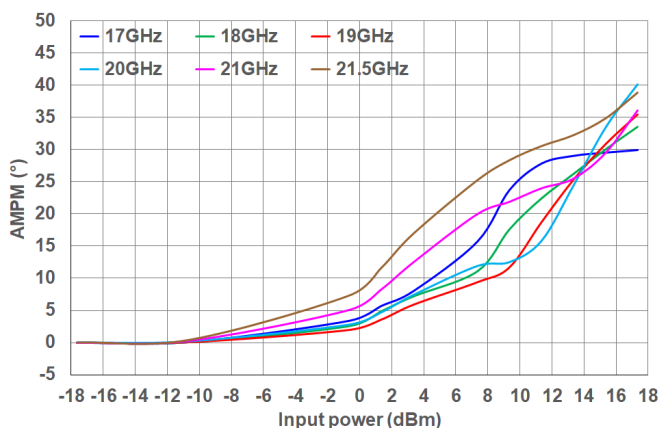
Board losses are de-embedded. Measurements are given in the package reference planes.

AMPM versus Input power

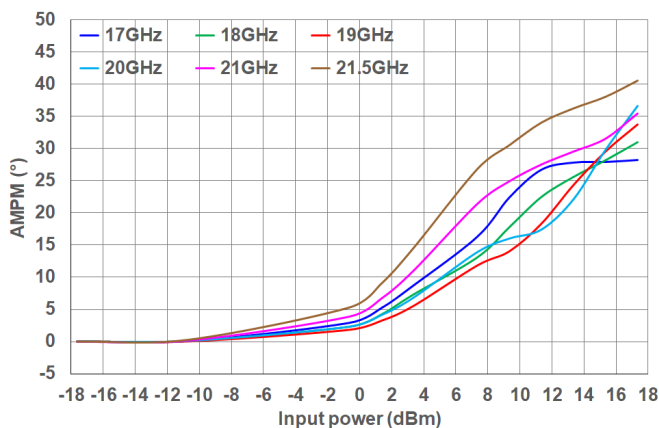
Tcase=-40°C



Tcase=25°C



Tcase=85°C



Advanced Information

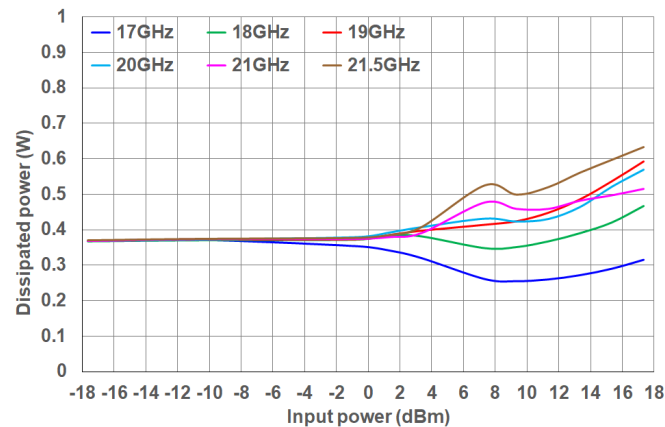
Typical Board Measurements : Large signal performance

Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C

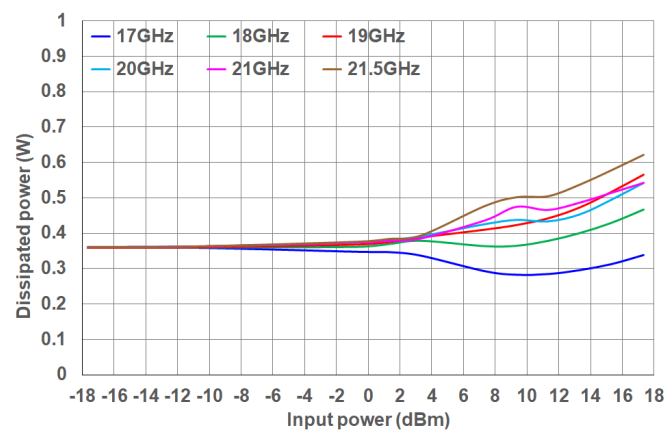
Board losses are de-embedded. Measurements are given in the package reference planes.

Dissipated power versus Input power

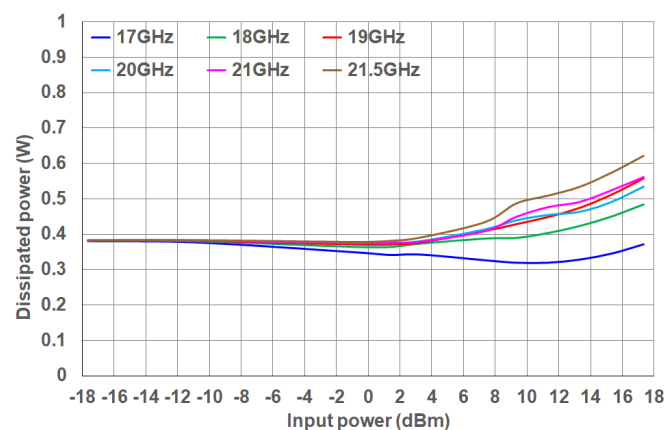
Tcase=-40°C



Tcase=25°C



Tcase=85°C



Advanced Information

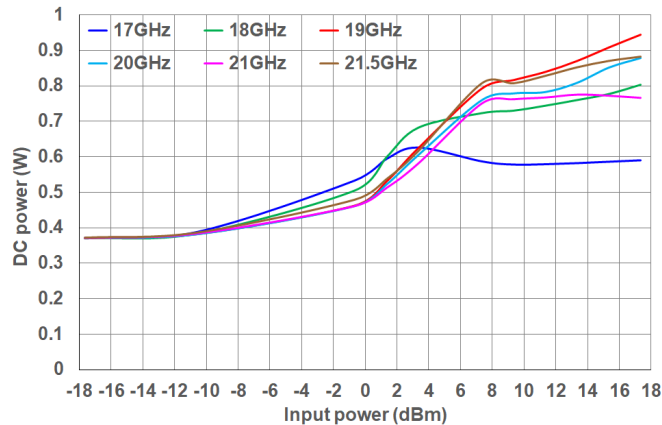
Typical Board Measurements : Large signal performance

Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C

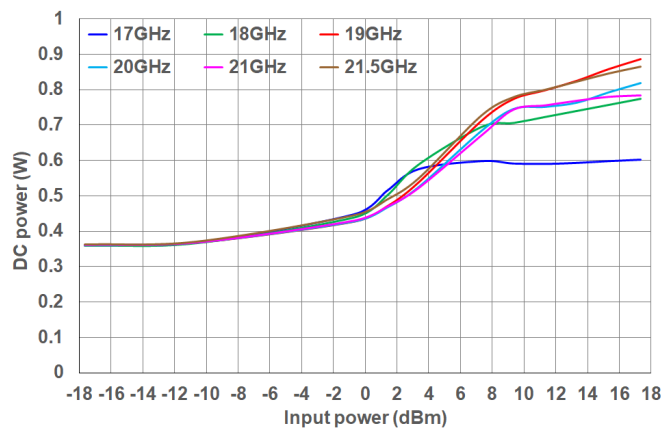
Board losses are de-embedded. Measurements are given in the package reference planes.

DC supply power versus Input power

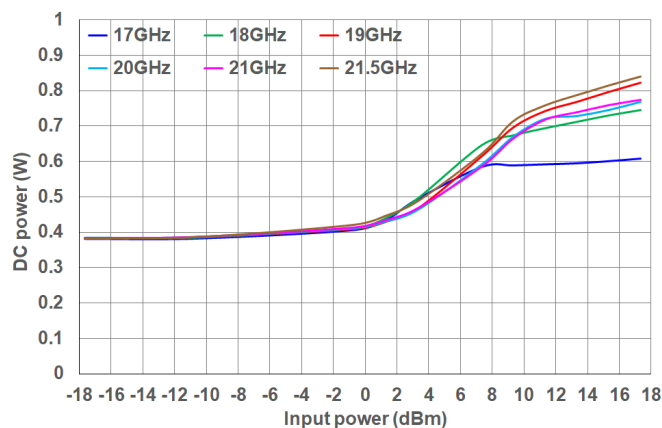
Tcase=-40°C



Tcase=25°C



Tcase=85°C



Advanced Information

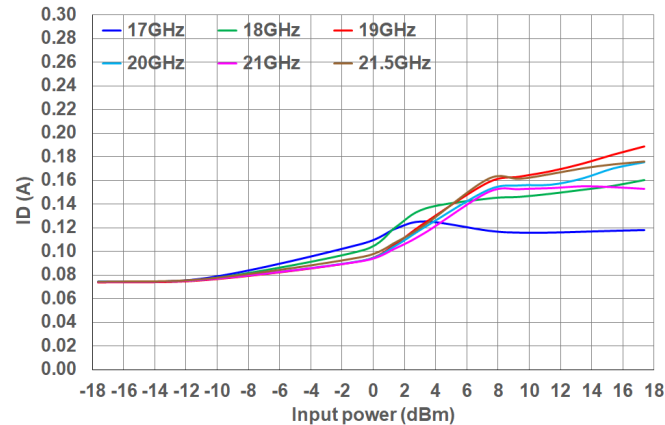
Typical Board Measurements : Large signal performance

Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C

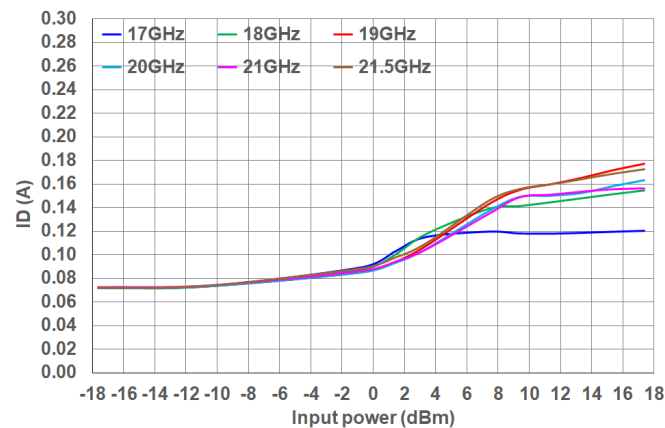
Board losses are de-embedded. Measurements are given in the package reference planes.

Drain supply current versus Input power

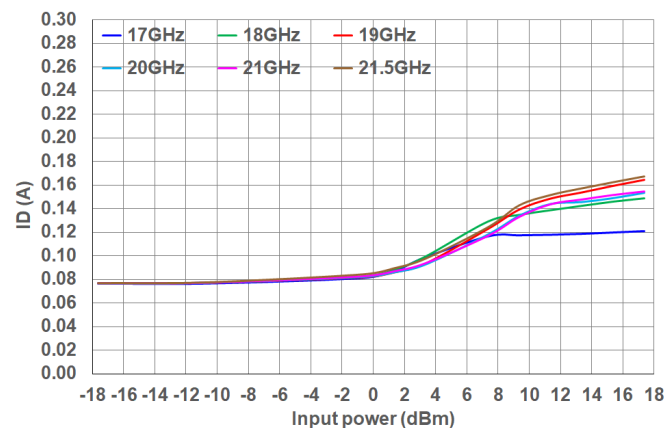
Tcase=-40°C



Tcase=25°C



Tcase=85°C



Advanced Information

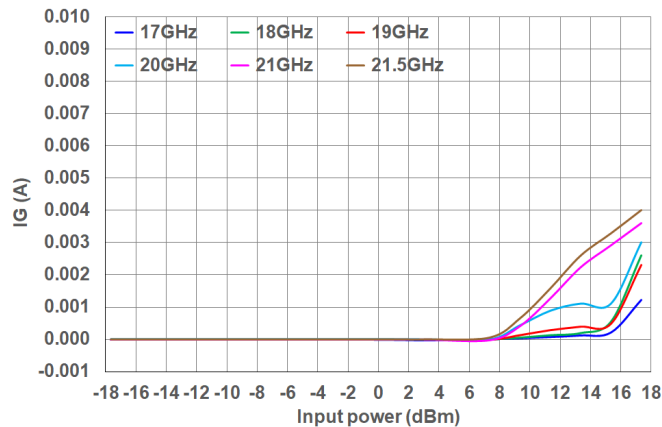
Typical Board Measurements : Large signal performance

Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C

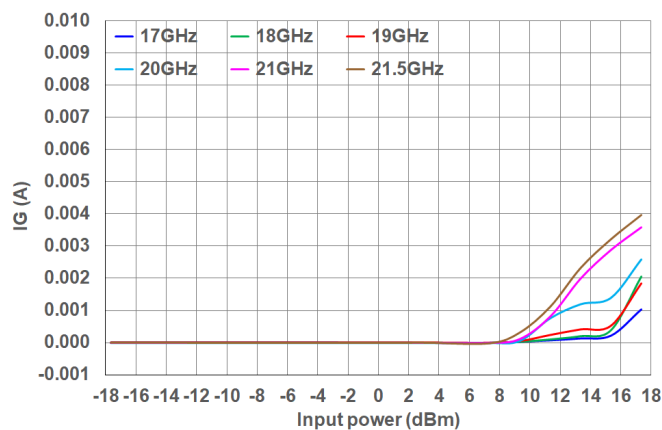
Board losses are de-embedded. Measurements are given in the package reference planes.

Gate supply current versus Input power

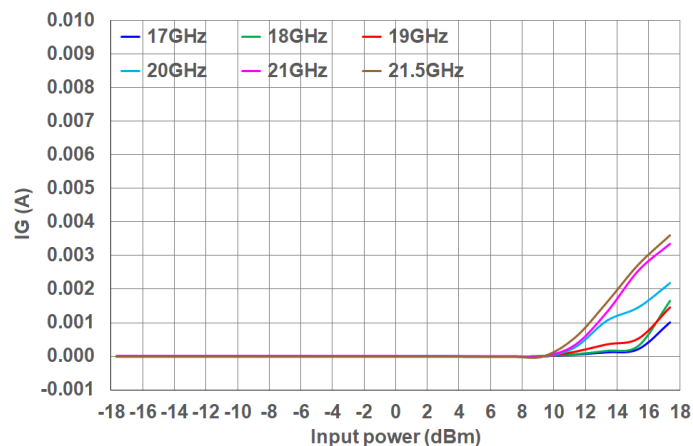
Tcase=-40°C



Tcase=25°C



Tcase=85°C



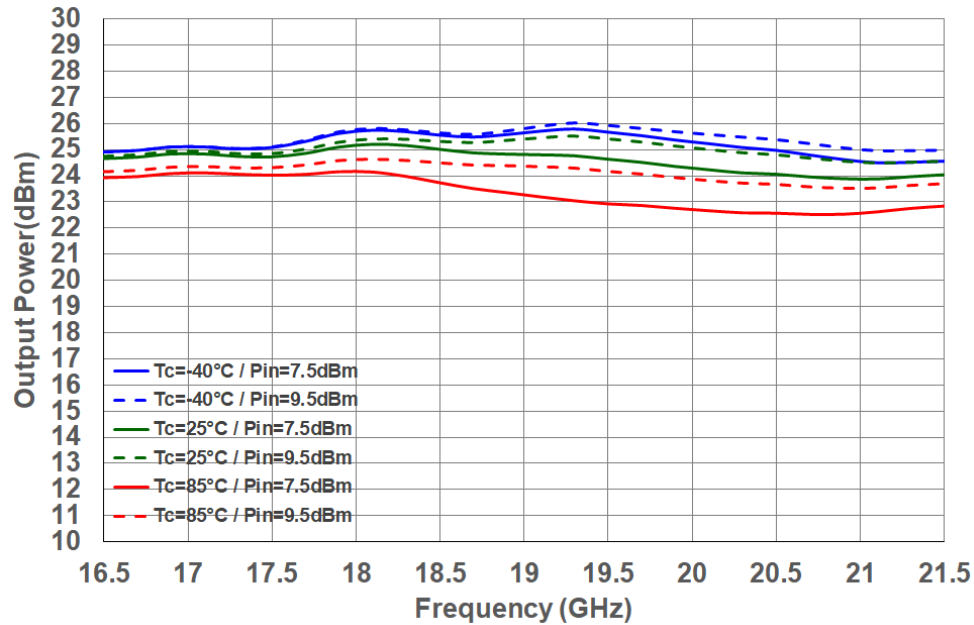
Advanced Information

Typical Board Measurements : Large signal performance

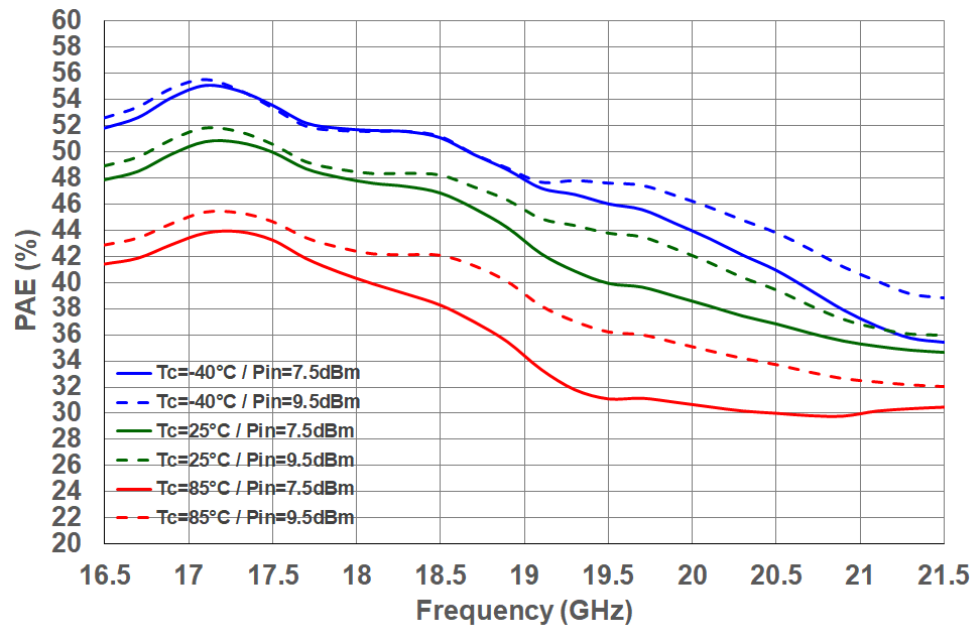
Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C

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



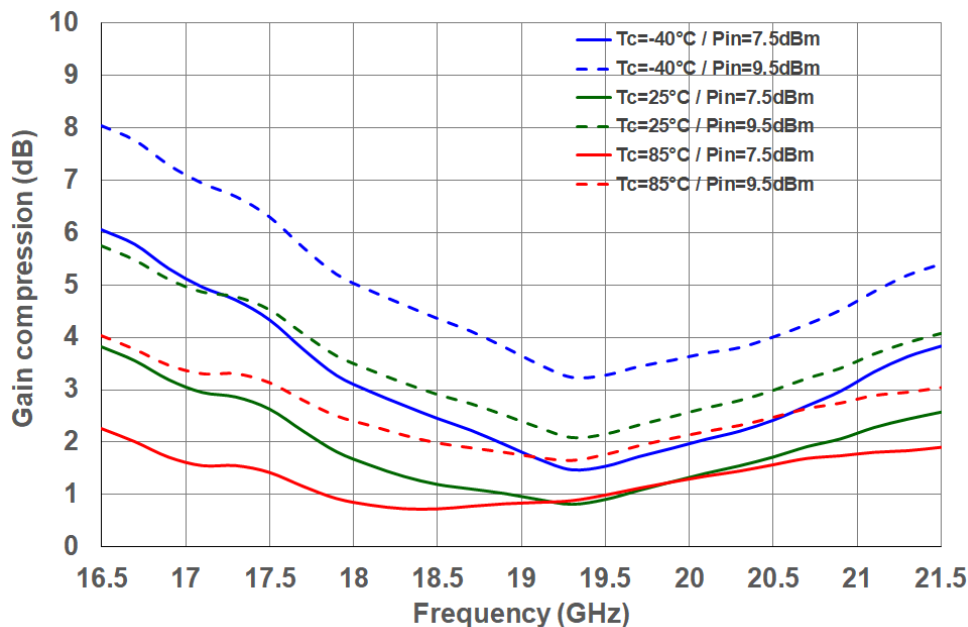
Advanced Information

Typical Board Measurements : Large signal performance

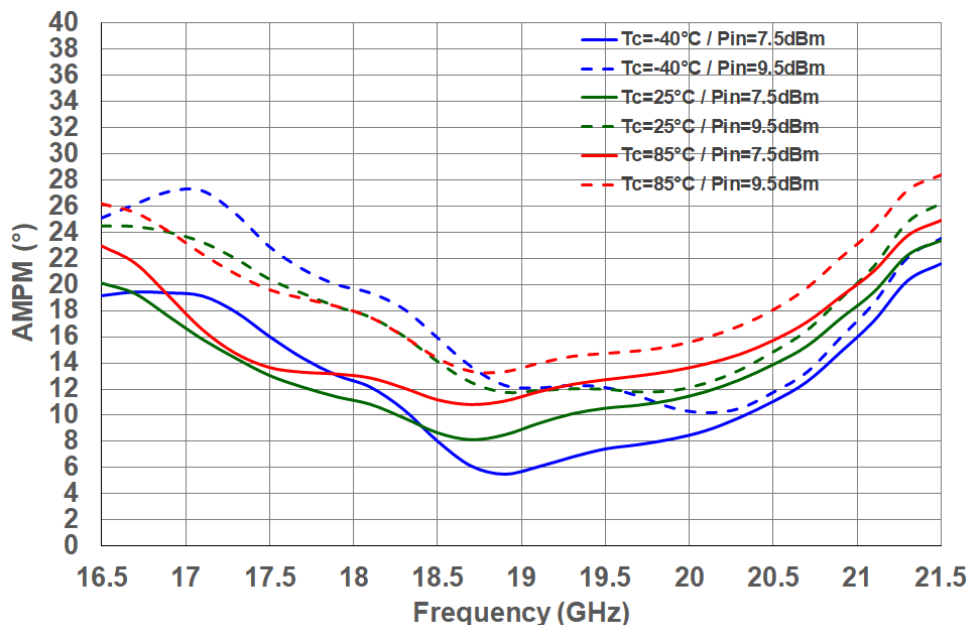
Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C

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

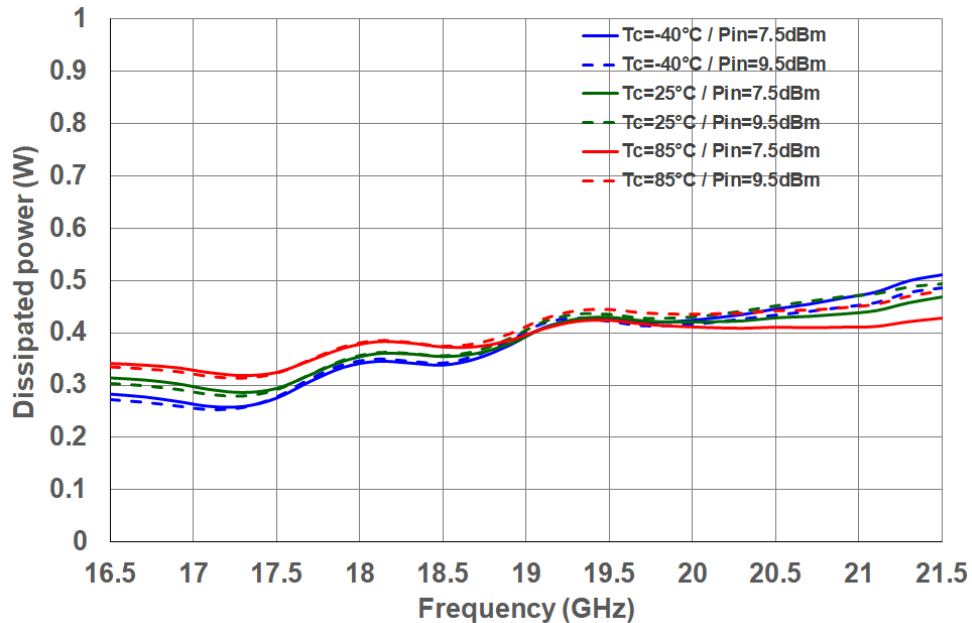
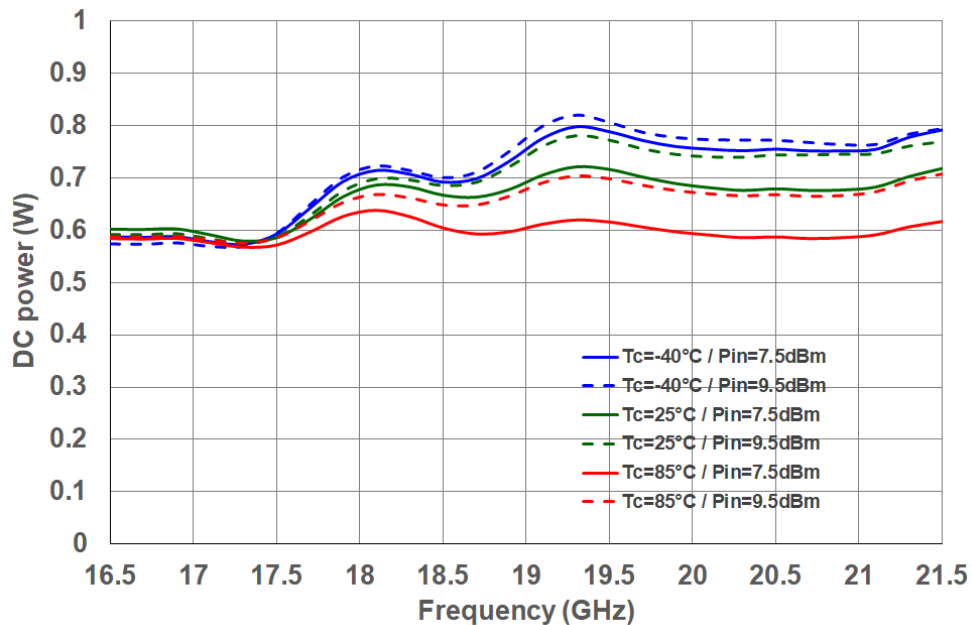


Advanced Information

Typical Board Measurements : Large signal performance

$V_d = 5V$, V_g fixed to set $I_{dq}=70mA$ @ $T_{case}=25^\circ C$

Board losses are de-embedded. Measurements are given in the package reference planes.

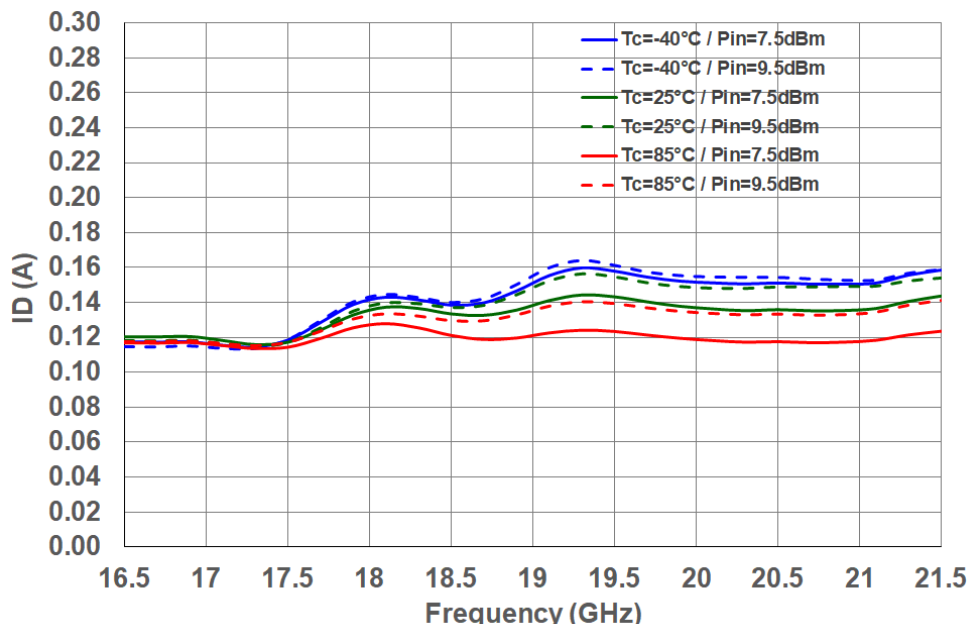
Dissipated power versus Frequency for several Input power and Temperature**DC supply power versus Frequency for several Input power and Temperature****Advanced Information**

Typical Board Measurements : Large signal performance

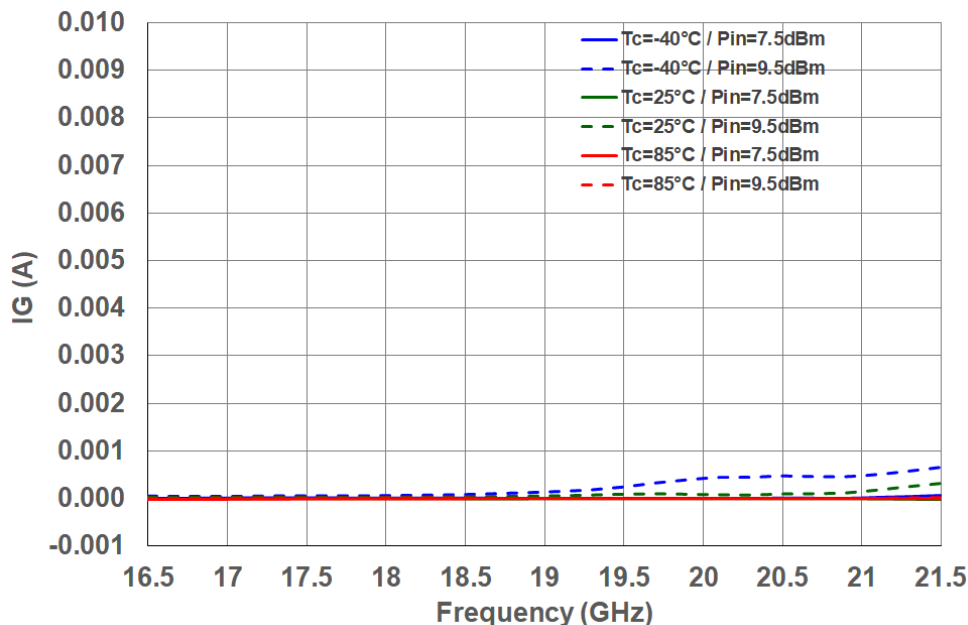
Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C

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



Advanced Information

Typical Board Measurements : Noise Power Ratio

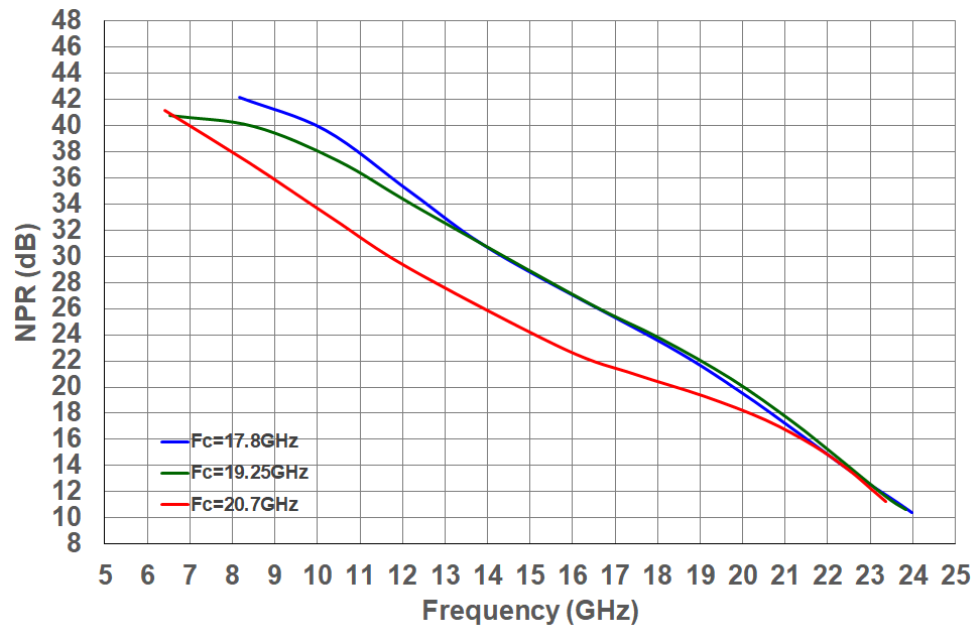
NPR Signal : 1GHz Signal Bandwidth, 10% Notch

Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C

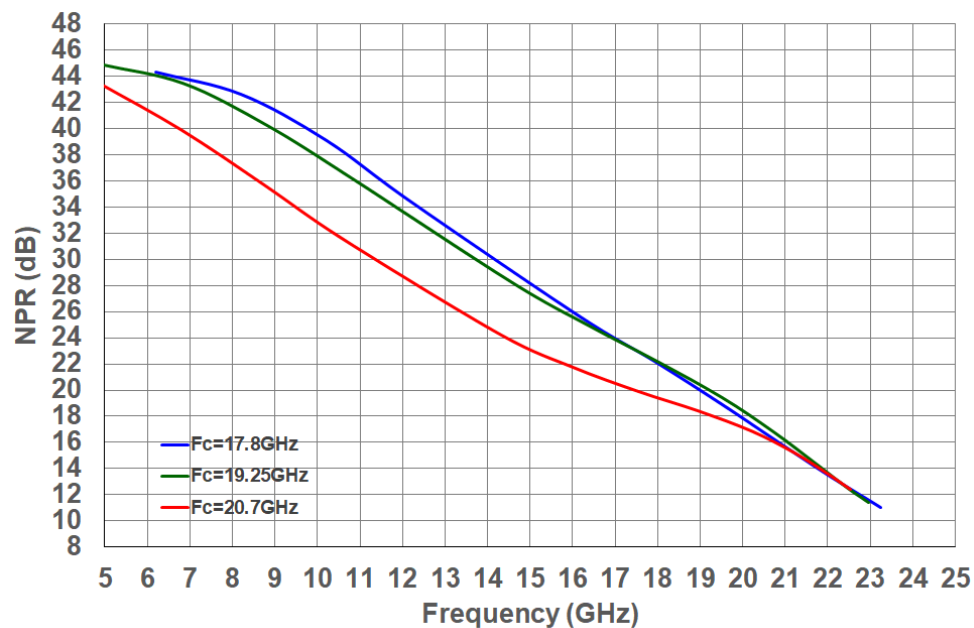
Board losses are de-embedded. Measurements are given in the package reference planes.

NPR versus Output Power and Central Frequency

Tcase=25°C



Tcase=85°C



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Typical Board Measurements : PAE associated to NPR Signal

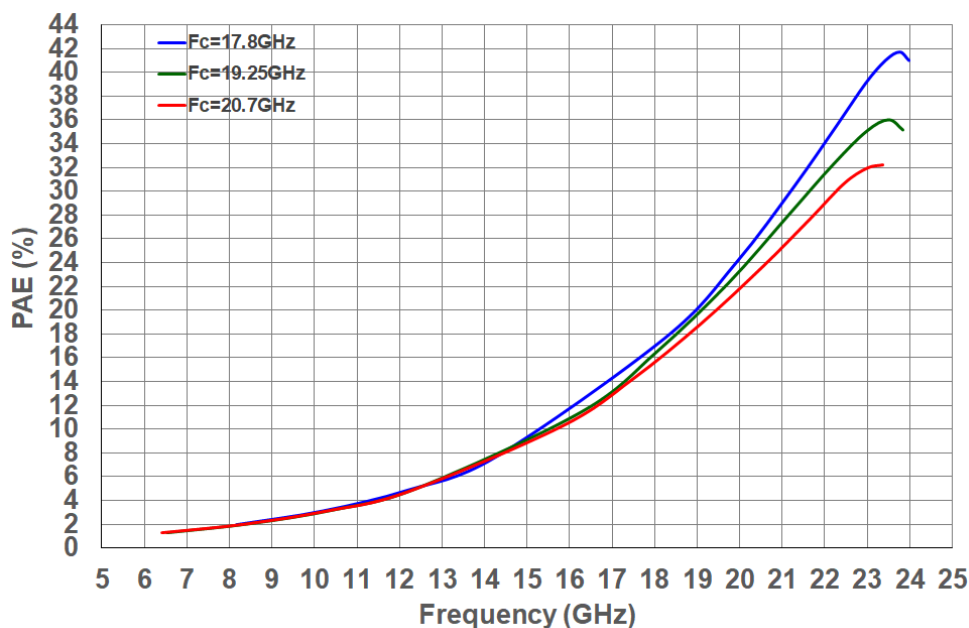
NPR Signal : 1GHz Signal Bandwidth, 10% Notch

Vd = 5V, Vg fixed to set Idq=70mA @ Tcase=25°C

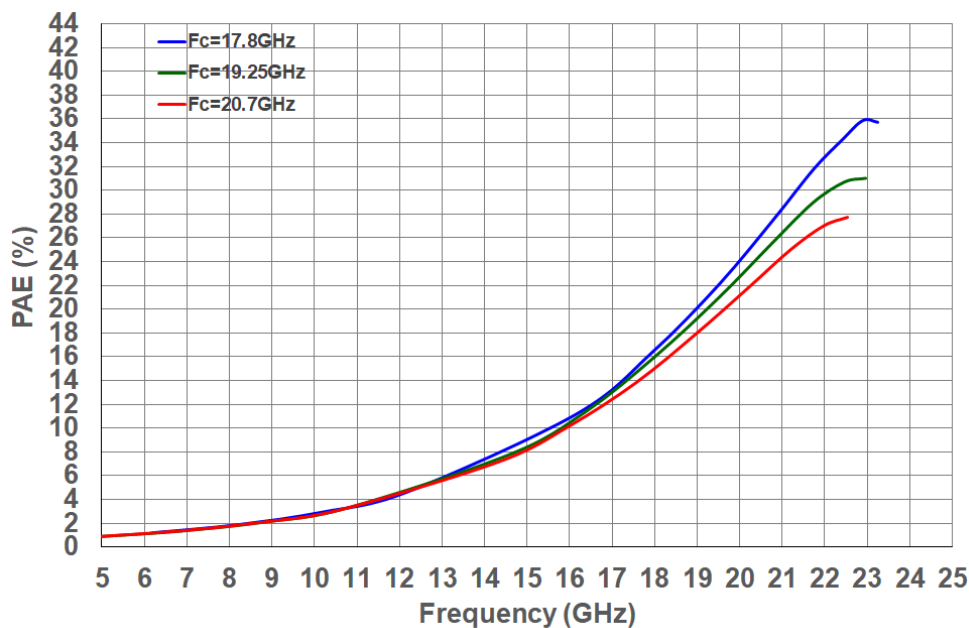
Board losses are de-embedded. Measurements are given in the package reference planes.

PAE versus Output Power and Central Frequency

Tcase=25°C



Tcase=85°C



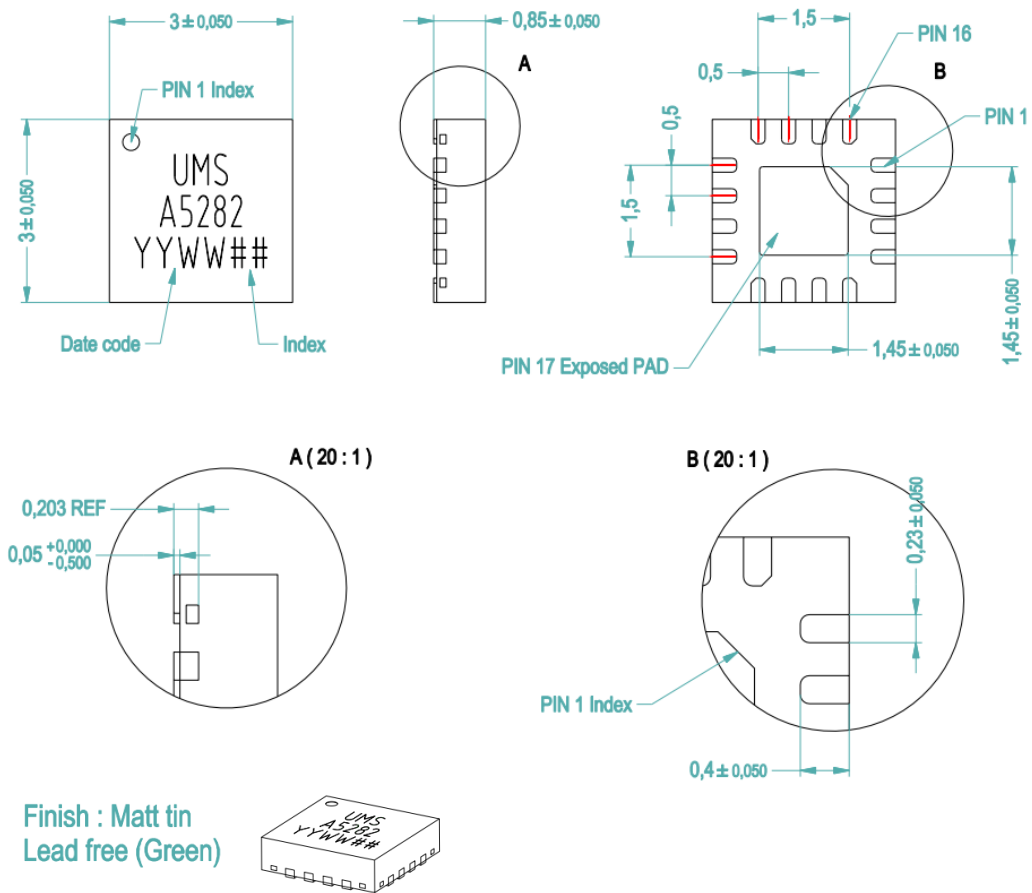
Advanced Information

17-21.5GHz Medium Power Amplifier

AI2414

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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⁾	
NC :	Not Connected	6- GND ⁽²⁾	13- GND ⁽²⁾	
		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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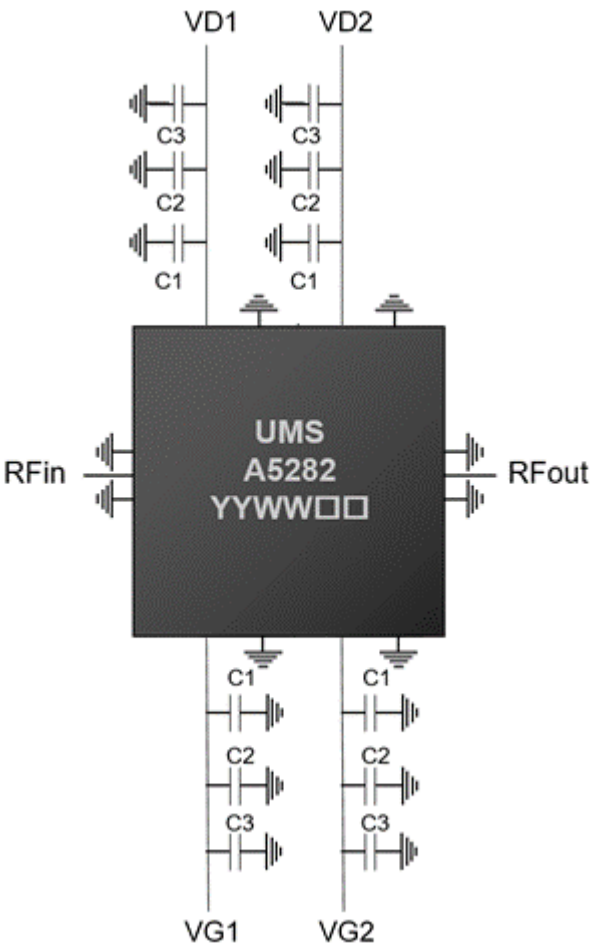


Package Information

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

Advanced Information

Recommended Assembly Plan



Bill of Materials

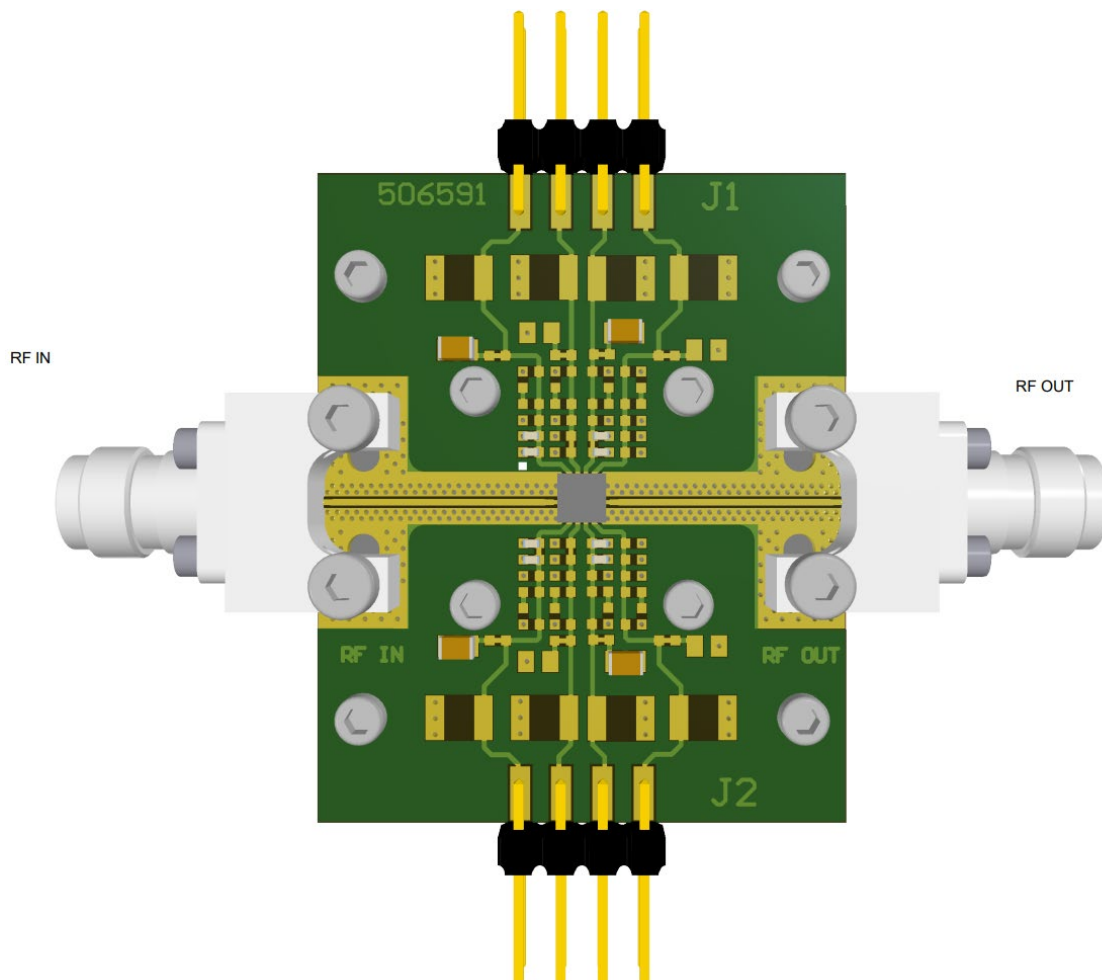
Label	Value	Description
C1	RF	Capacitor 120pF ±15%
C2	RF	Capacitor 10nF ±10%
C3	RF	Capacitor 1µF ±10%

Advanced Information



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 $\pm 10\%$ 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.

Advanced Information

17-21.5GHz Medium Power Amplifier

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Notes

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Recommended package footprint

Refer to the application note AN0017 available at <http://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 available at <http://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 <http://www.ums-rf.com>.

Recommended ESD management

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

Maturity Level

Maturity Level	Product status	Documentation	Reliability	Usage in a system
Lab Sample (LS)	Decision to develop the product is not confirmed	Technical Information	No commitment	Lab demonstrator
Engineering Sample (ES)	Design may change	Advanced Information	The design is within the recommended temperature, current and voltage ranges as regards the technology used.	Engineering demonstrator
Product Representative Unit (PRU)	Design is frozen	Data-sheet	Tests results are available on the foreseen product or on an similar one	Production

Sampling request reference

Package: ES-CHA5282-QAG
Demo board: EDG-CHA5282-QAG

Contact us

Web site: <https://www.ums-rf.com>
e.mail: mktsales@ums-rf.com
Phone: +33 (1) 69 86 32 00 (France)
+1 (781) 791-5078 (USA)
+65 9298 8316 (Singapore)

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