TDPA4220QFN

Wideband (0.5 GHz – 20 GHz) Medium Power Amplifier

Product Overview

The TDPA4220QFN is a distributed, wideband, Driver Amplifier designed for a wide range from UHF to K-band applications, such as electronic warfare, point-to-point Radio, and test instrumentation.

The MPA driver operate over frequency bands of 0.5 to 20 GHz and provides 17 dB of linear gain while providing a typical output power of 20 dBm at 1dB gain compression.

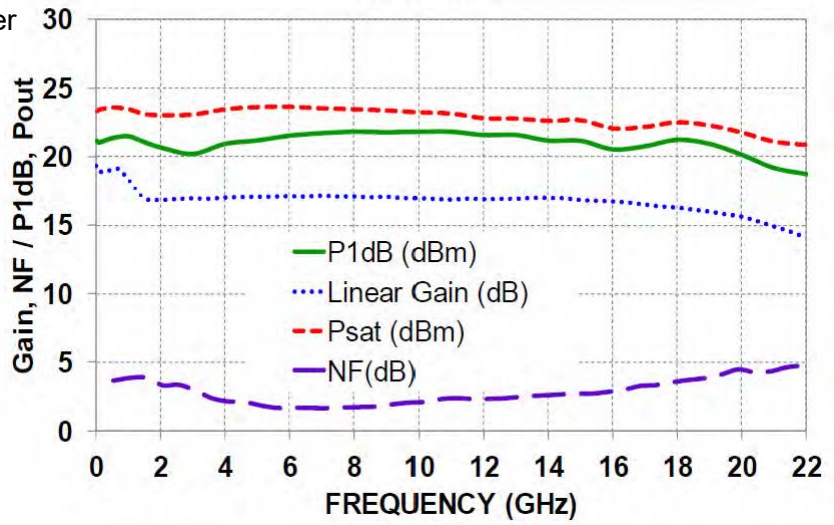
The amplifier is manufactured in a 0.25 µm drawn gate length power pHEMT process technology via holes through the substrate, air bridges, and optical gate lithography.

The part is supplied in a leadless surface mount 28-pin 25 mm^2 QFN package. The circuit is ideal for a wide range of microwave and millimeter wave applications and systems.

Features

- Frequency band: 0.5 – 20 GHz
- Output power: 20 dBm @1 dBcomp
- Linear gain: 17 dB
- P1dB: 20 dBm
- Psat: 23 dBm
- OIP3: 28 dBm
- Noise Figure: 3 dB
- Quiescent bias point: Vd = 8 V, Id = 190 mA
- 28-pin QFN 5 x 5 mm^2
- MSL Level: 3

Performance



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Absolute Maximum Ratings(1)

Tamb.= +25°C

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	8	V
Idq	Drain bias current	170	mA
Vg1	Gate bias voltage Vg1	-2 to 0	V
Vg2	Gate bias voltage Vg2	1 to 2	V
Pin	Maximum CW input power overdrive	17	dBm
Tj	Maximum junction temperature(2)	175	ºC

(1) Operation of this device above anyone of these parameters may cause permanent damage.
(2) Thermal resistance channel to ground paddle.

Recommended Operating Conditions

Ta = +25 °C

Symbol	Parameter	Min	Typ	Max	Unit
Fop	Frequency range	0.5		20	GHz
Gain	Linear gain		17		dB
NF	Noise Figure		3		dB
Pout	Output power @ 1dBcomp		20		dBm

Electrical Specifications

Tamb = +25 °C, Vg1 to be set in order to have Idq = 120 mA, Vg2 = 1.5 V

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	0.5		20	GHz
G	Linear gain		17		dB
NF	Noise Figure		3		dB
IRL	Input Return Loss		15		dB
ORL	Output Return Loss		18		dB
P-1dB	Output power @ 1dBcomp		20		dBm
Psat	Saturated output power		23		dBm
OIP3	Output Third Order Intercept		28		dBm
Idq	Quiescent current on Vd		120		mA
Vd	Supply voltage on Vd	6	6.5	7	V
Id	Drain current @3dB gain compression		140		mA

The values are representative of typical “test fixture” measurement as defined on the drawing in paragraph “Proposed Evaluation Board”.

Temperature Range

Symbol	Parameter	Min	Typ	Max	Unit
Ta	Operating temperature range	-- 40		+95	ºC
Tstg	Storage temperature range	-- 55		+150	ºC

Device Thermal Performance

All the figures given in this section are obtained assuming that the QFN device is cooled down only by conduction through the package thermal pad (no convection mode considered).
The temperature is monitored at the package back-side interface (Tcase) as shown below. The system maximum temperature must be adjusted in order to guarantee that Tcase remains below than the maximum value specified in the next table. So, the system PCB must be designed to comply with this requirement.

A derating must be applied on the dissipated power if the Tcase temperature can not be maintained below than the maximum temperature specified (see the curve Pdiss. Max) in order to guarantee the nominal device life time (MTTF).

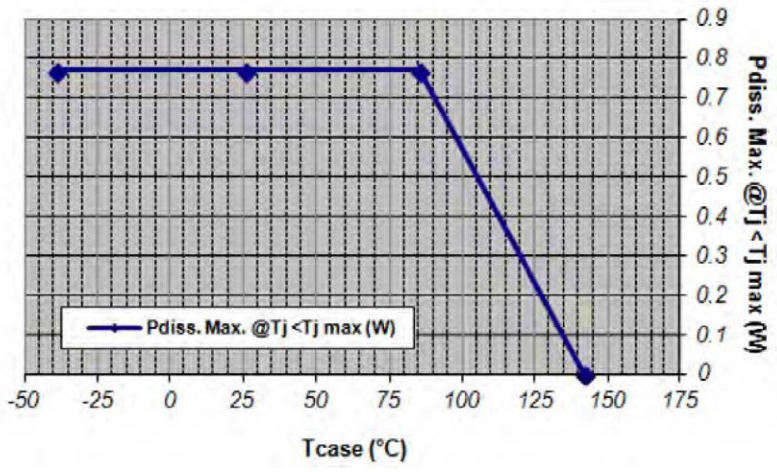
The provided thermal information in the next chart is for nominal biasing point: Idq = 110 mA and Vd = 7 V, without RF drive @ Tcase = 85 ºC.

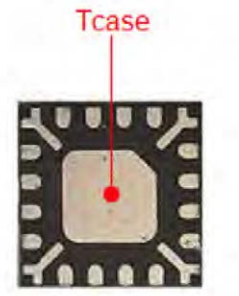
DEVICE THERMAL SPECIFICATION: TDPA4220-QFN			
Recommended max. junction temperature (Ij max)			145 °C
Junction temperature absolute maximum rating			175 °C
Max. continuous dissipated power@Tcase=	85	°C	0.8 W
=> Pdiss derating above Tcase[1]>=	85	°C	14 mW/°C
Junction-Case thermal resistance (Rth J-C)[2]			73.5 °C/W
Min. package back side operating temperature[3]			-40°C
Max. package back side operating temperature[3]			85 °C
Min. storage temperature			-55 °C
Max. storage temperature			150 °C

(1 Derating at junction temp constant= Tj max

(2) Rth J-C is calculated for a worse case where the hottest junction of the MMIC is considered.

(3) Tcase=Package back side temperature measured under lhe die-attach-pad (see the drawing below)

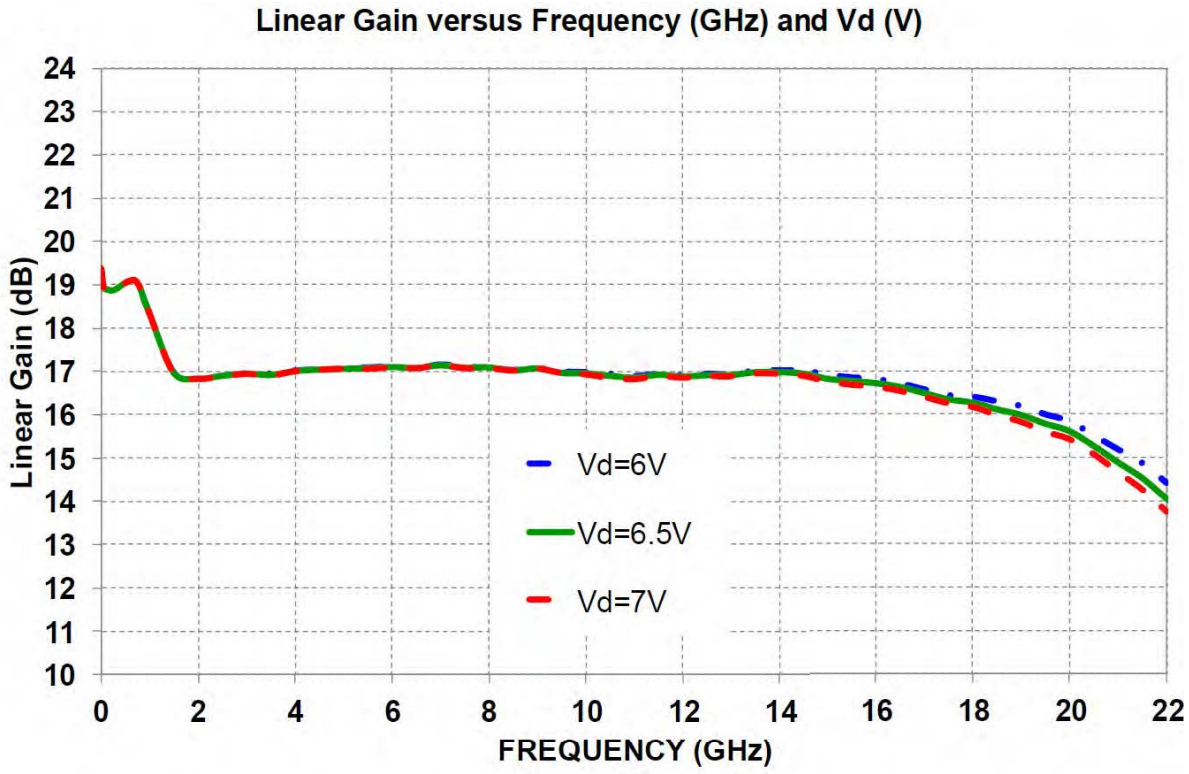


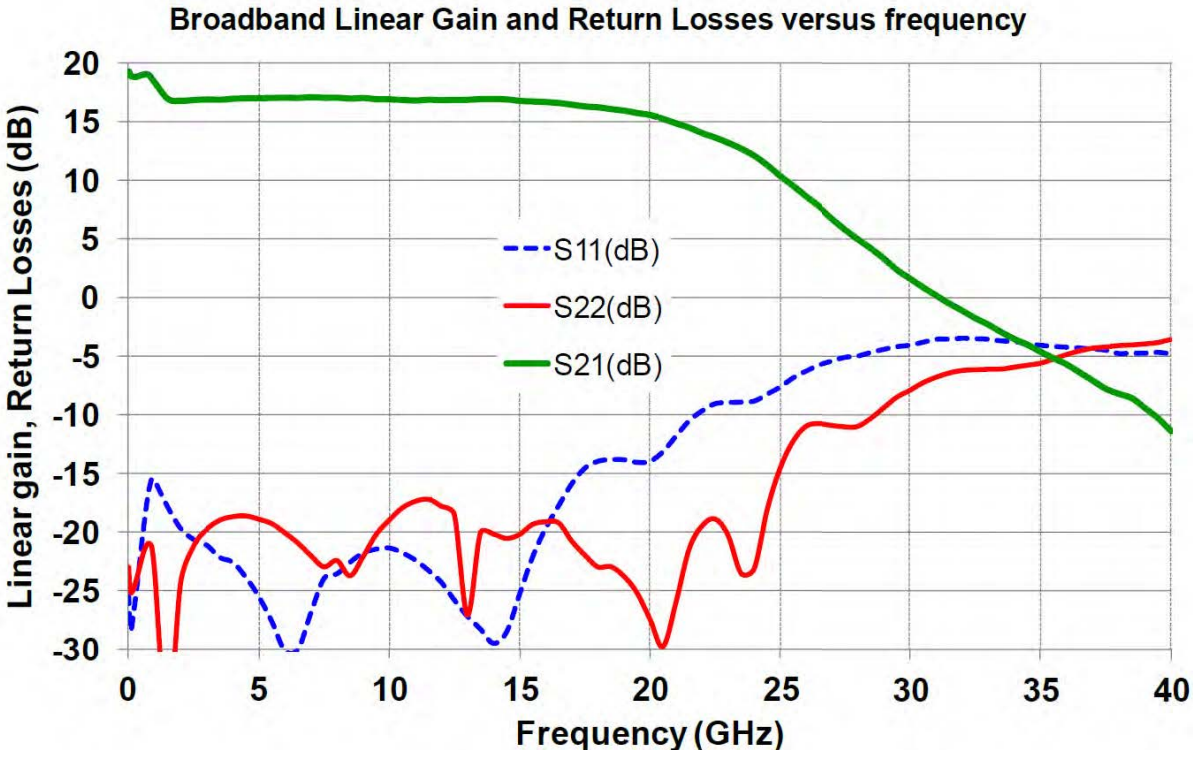


Example: QFN 16L 3x3
Location of temperature reference point (Tcase) on package's bottom side

Typical Board Measurements

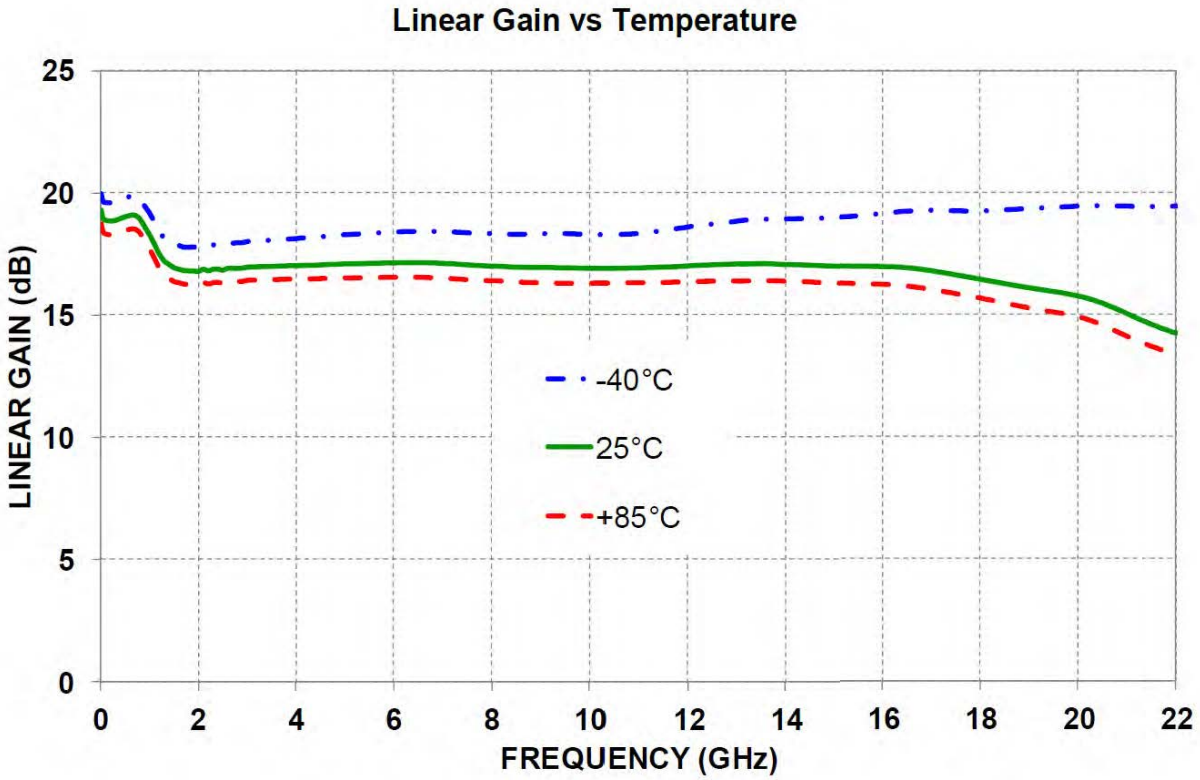
Tamb = +25º C, Vd = 6.5V, Vg1 set in order to get Idq = 120 mA, Vg2 = 1.5 V

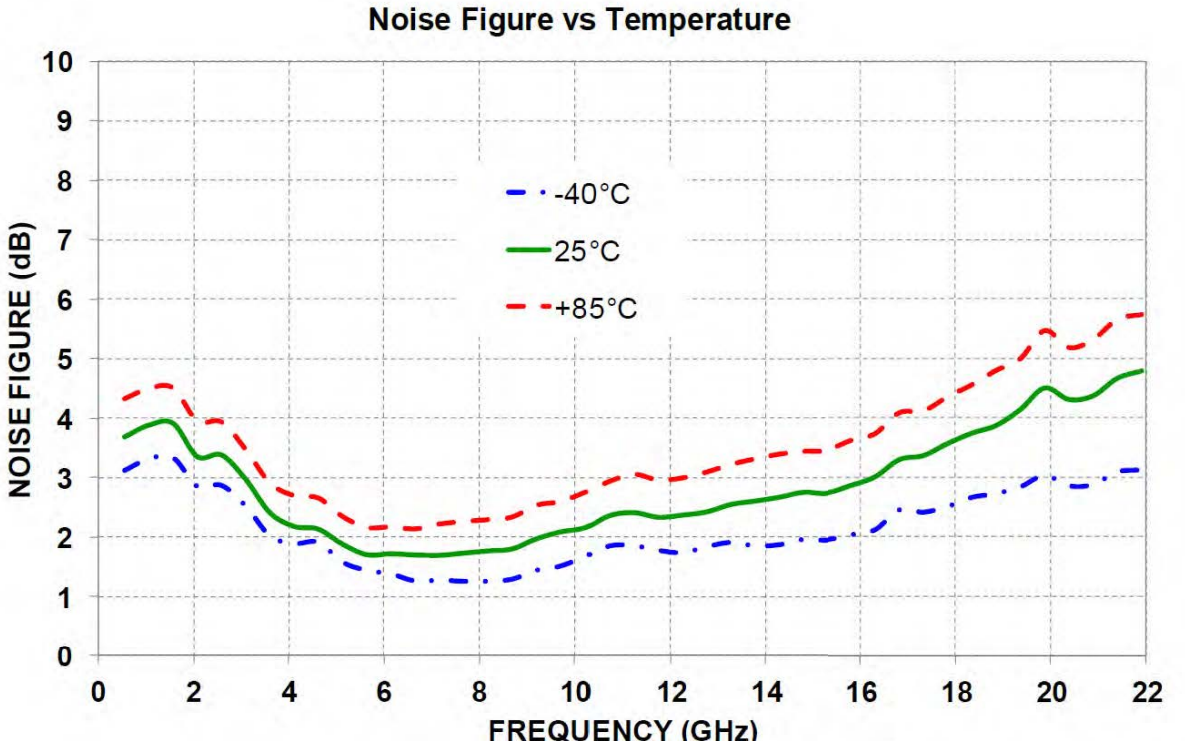




Typical Board Measurements

Vd = 6.5 V, Vg1 set in order to get Idq = 120 mA @ Tamb = +25 ºC with Vg2 = 1.5 V, Vg1 and Vg2 remain constant versus temperature (Tamb = +25 ºC, +85 ºC, -40º C)





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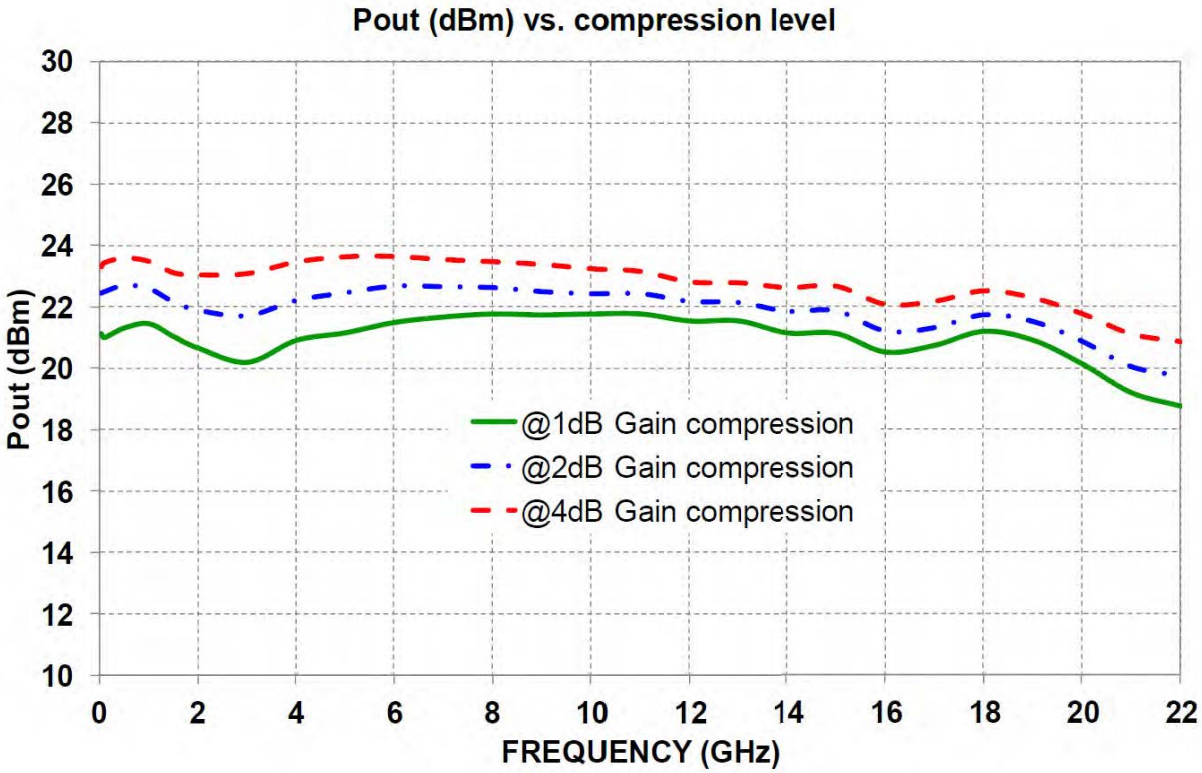

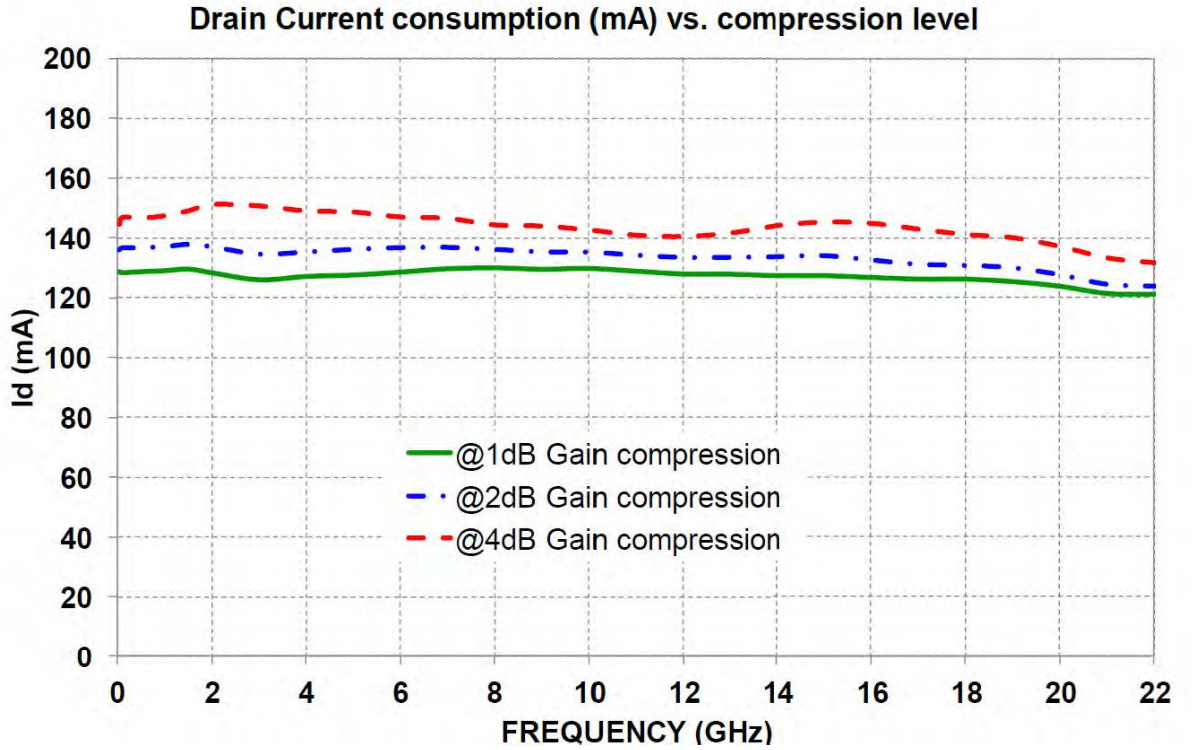

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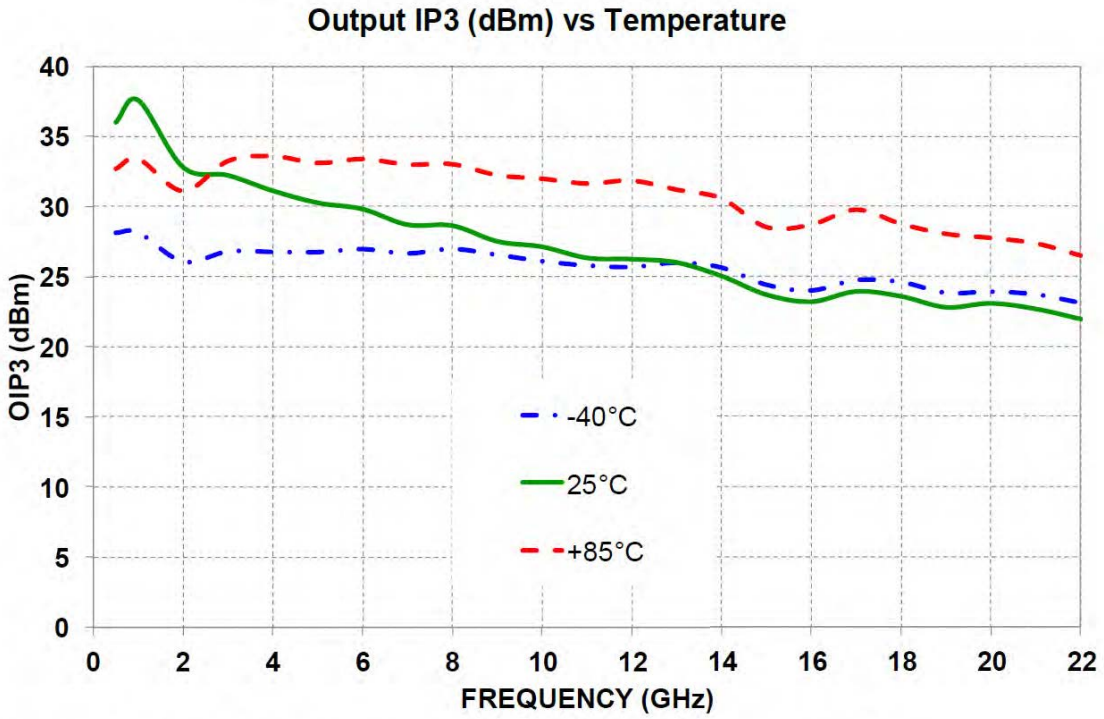

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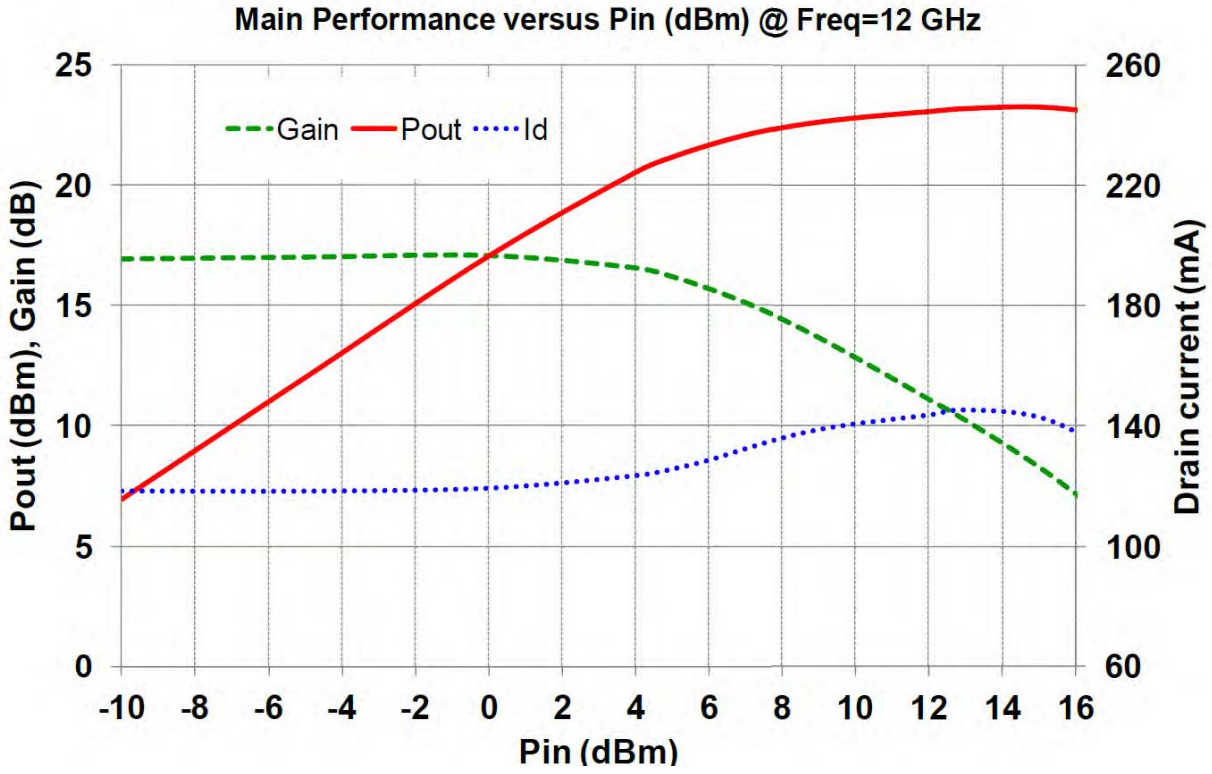
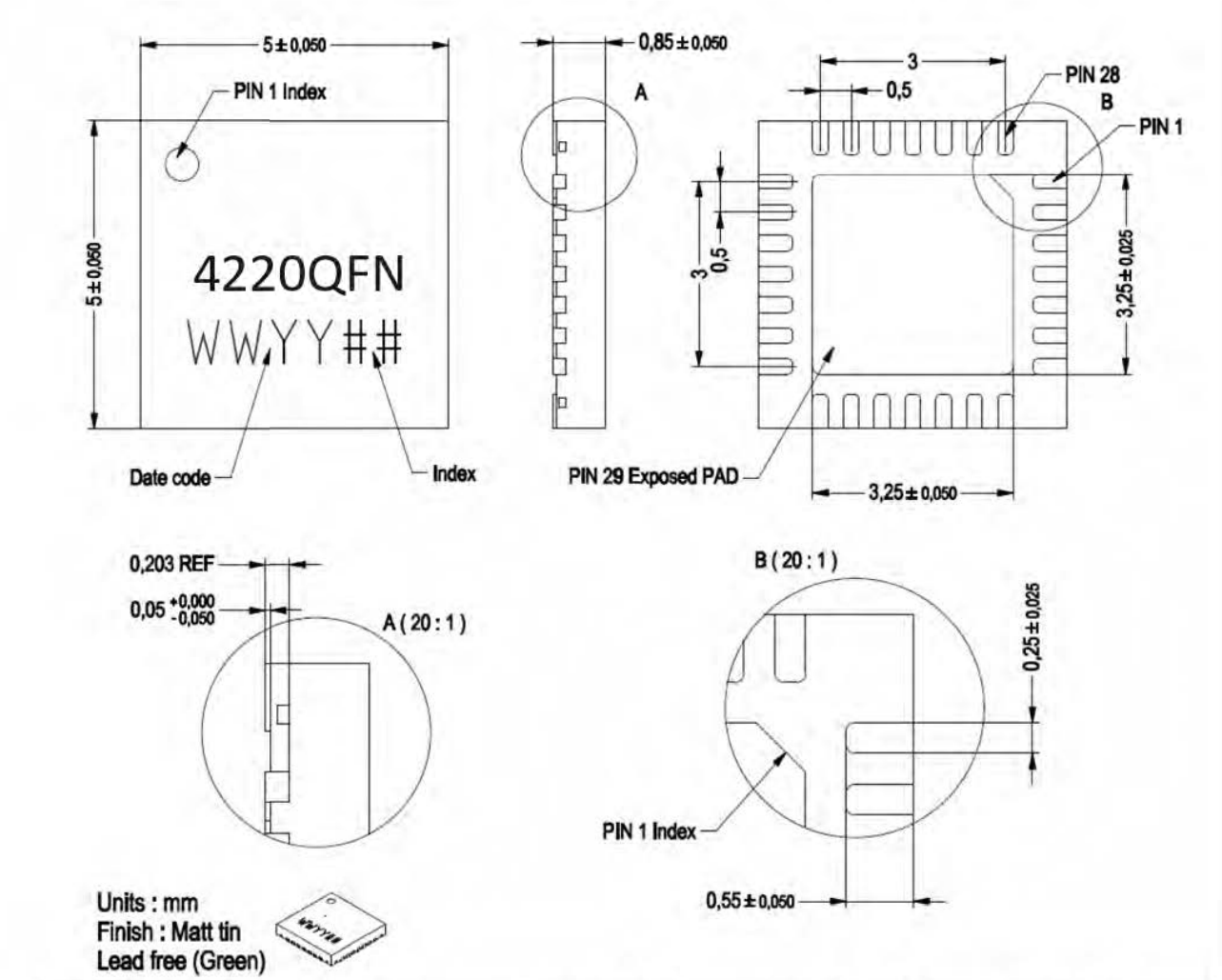


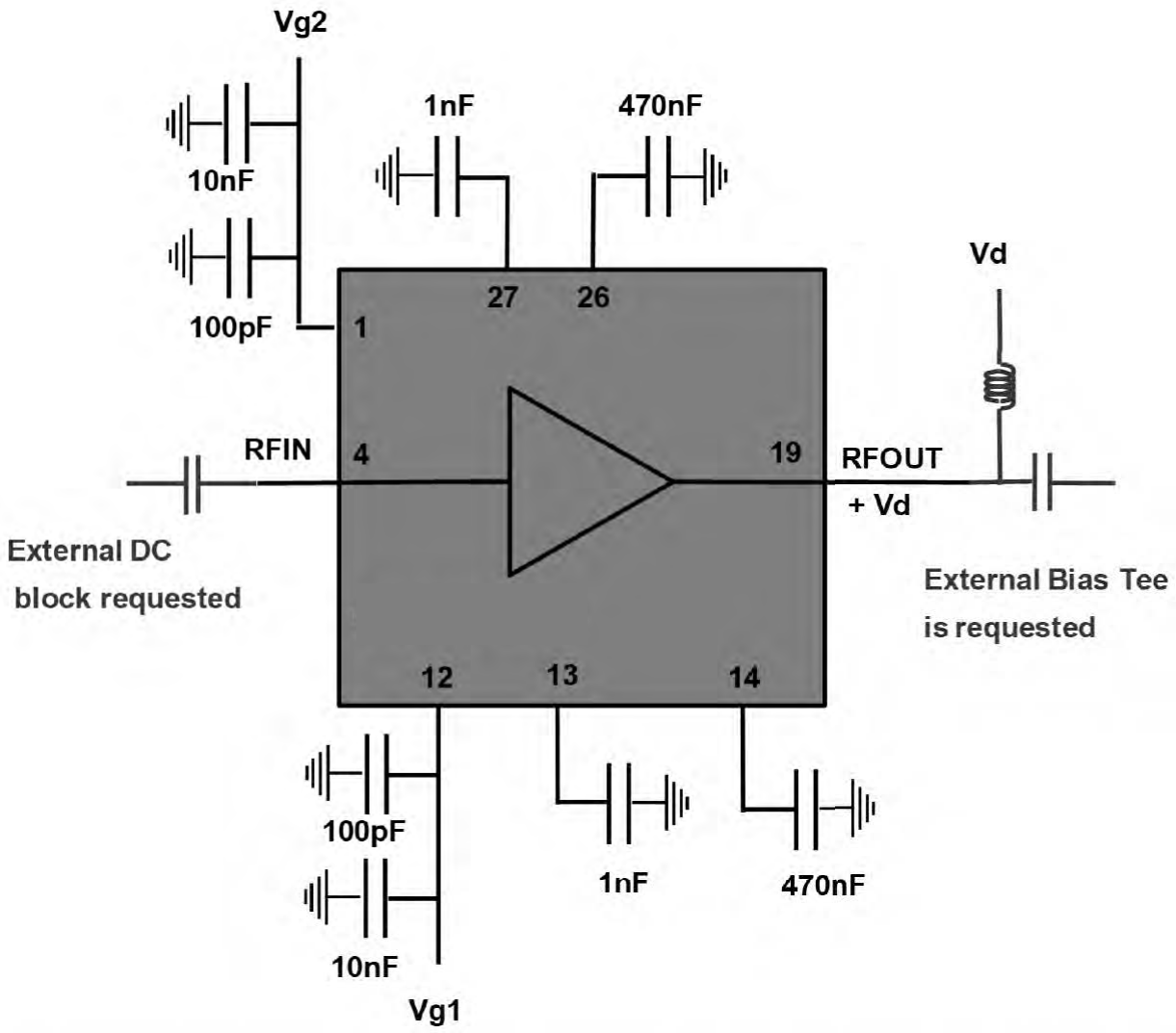
Package Outline: 28 Lead 5 x 5 QFN(1)



Matte tin, Lead Free	(Green)	1- VG2	11- GND(2)	21- Nc
Units :	mm	2- Nc	12- VG1	22- Nc
From the standard :	JEDEC MO-220	3- Nc	13- ACG4	23- Nc
	(VHHD)	4- RF in	14- ACG3	24- Nc
29-	GND	5- GND(2)	15- Nc	25- Nc
		6- Nc	16- Nc	26- ACG2
		7- Nc	17- Nc	27- ACG1
		8- Nc	18- GND(2)	28- Nc
		9- Nc	19- RF out +VD	
		10- Nc	20- Nc	

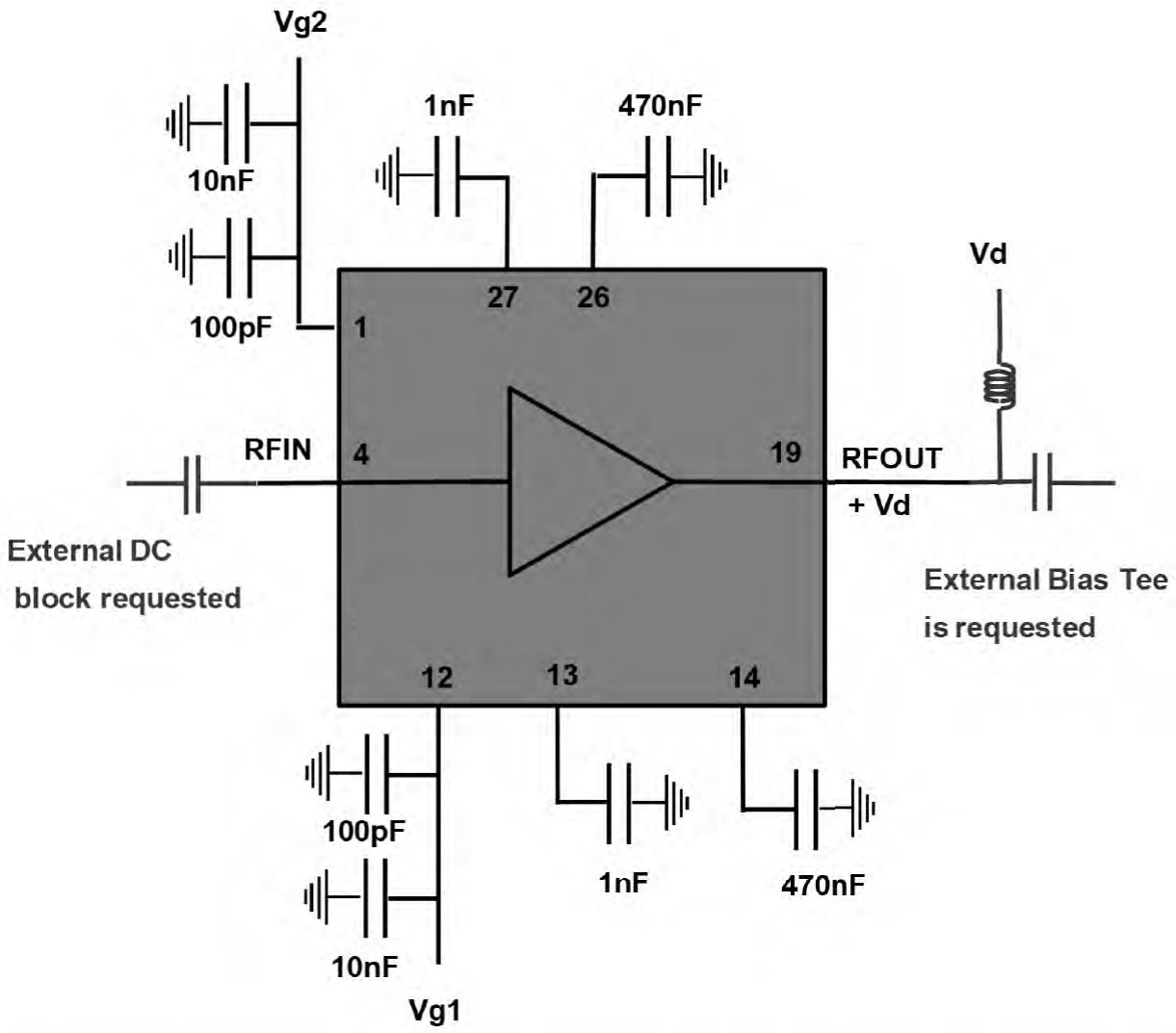
(1) The package outline drawing included in this data sheet is provided for indication purposes.
(2) It is strongly recommended to ground all pins marked "Gnd" through the PCB board. Ensure that the PCB board is designed to provide the best possible ground to the package.

Application Circuit



Note: external components are requested in order to use the part properly and to reach the presented performance data: on RF input access a DC block is requested, on RF output access a Bias Tee is requested.
Depending on the board, additional capacitors such as 1µF may be added on Vg1 or Vg2 access if necessary, for better low frequency decoupling.
Smaller capacitors than 470nF could be use if the part is not use in low frequency range (< 1 GHz): 10nF.

Application Circuit



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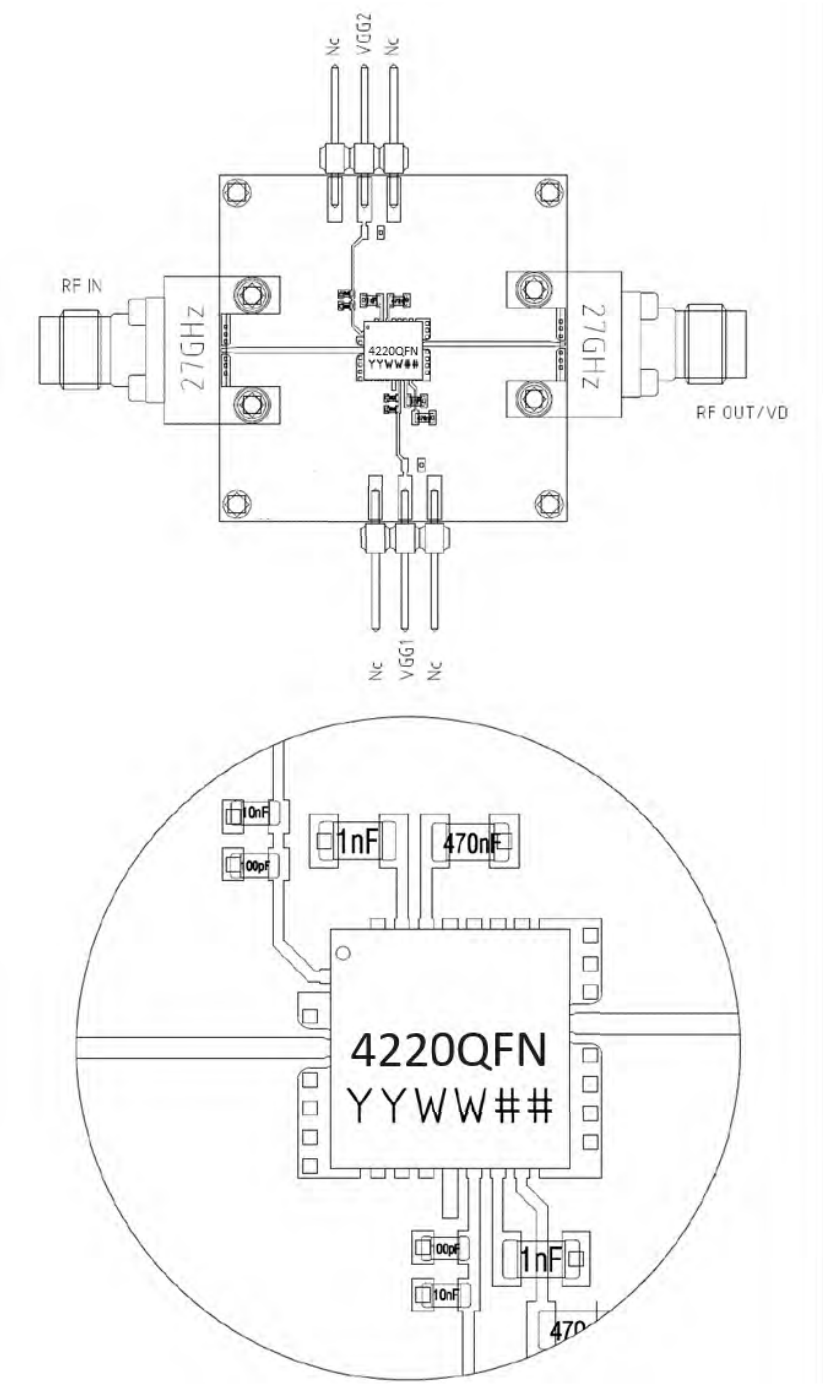
Pin Description

Pin	Symbol	Description
5, 18, 29 (exposed PAD)	GND	Must be grounded properly, internal connections to ground are made
2,3,6,7,8,9,10,15, 16,17,20,21,22,23,24,25,28	NC	No internal connections
4	RF IN	RF input, DC coupled to Vg1
12	VG1	Gate voltage, bias network required
1	VG2	Gate voltage bias network required
19	RF OUT + VD	RF output + Vd bias (see application circuit)
13	ACG4	Low frequency termination4 on Vg1
14	ACG3	Low frequency termination3 on Vg1
26	ACG2	Low frequency termination2 on Vd
27	ACG1	Low frequency termination1 on Vd

Teledyne recommends to ground pins 2, 3, 6, 7, 11, 15, 16, 17, 20 and 21

Evaluation Board

- 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 100 pF ±5% on Vg1 and Vg2 at first level; and 10 nF±10% at second level; additional 1 µF capacitors on each Vg accesses.
- Low frequency terminations are closed on 1nF and 470 nF are recommended.



Device Operation

Device Power Up instructions:

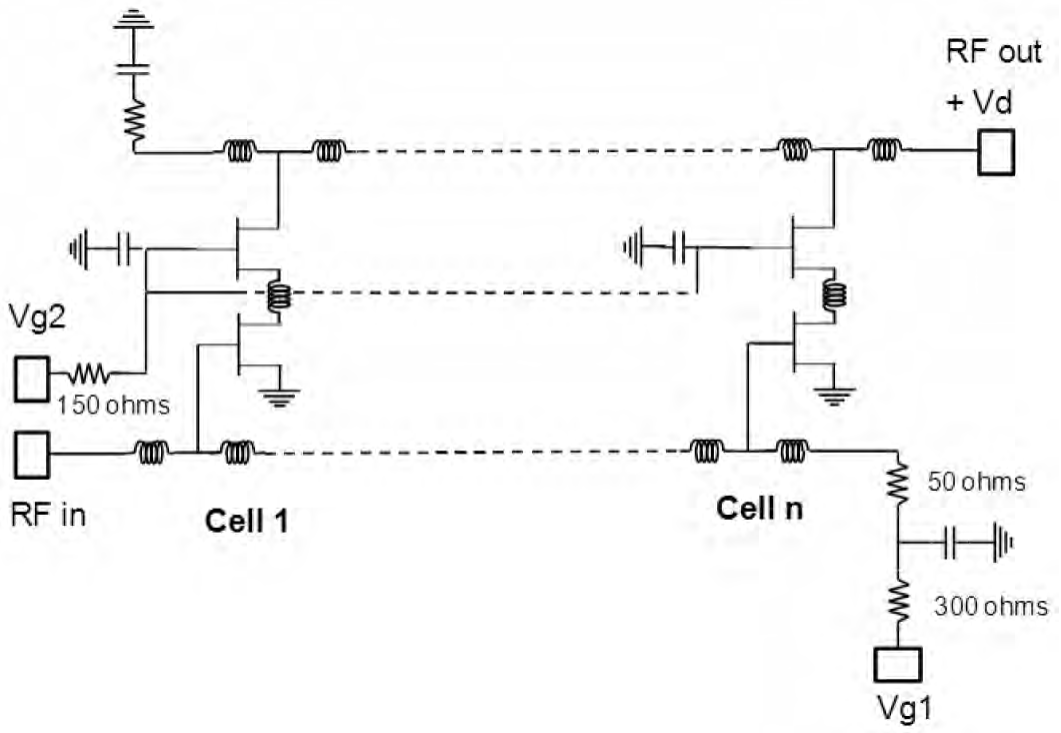
1) Ground the device.
2) Set Vg1 to -1.5V.
3) Set Vd to 6.5V (nominal value for Vd).
4) Set Vg2 to 1.5V (nominal value for Vg2).
5) Set Vg1 in the range of -0.3V for having Idq=120mA.
6) Apply RF input power and adjust Vg2 to obtain desired gain.

Device Power Down instructions:

1) Turn RF power supply off.
2) Set Vg1 to -1.5V in order to get Idq=0mA.
3) Set Vg2 to 0V.
4) Set Vd to 0V.
5) Set Vg1 to 0V.

DC Schematic

Vd = 6.5V, Vg1 = -0.3V, Vg2 = 1.5V, Idq = 120mA



Package Information

Parameter	Values
Package body material	RoHS-compliant Low stress injection Molded Plastic
Lead finish	100% matte-Tin (Sn)
MSL Rating	MSL3

Ordering Information

Order Code	Description	Package	Shipping Method
TDPA4220QFN	Wideband Medium Power Amplifier	5 x 5 28-Pin QFN	Tape and Reel
TDPA4220QFN-EVK	Wideband Medium Power Amplifier Evaluation Kit	Boxed	Boxed

Revision Information

Document	Description / Date	Change/Revision Details
TDPA4220QFN-4-2024 Rev 0.2	TDPA4220QFN / April 2024	Initial Release

Document Categories and Definitions:

Advance Information

The product is in a formative or design stage. The data sheet contains design target specifications for product development. Specifications and features may change in any manner without notice.

Preliminary Specification

The data sheet contains preliminary data. Additional data may be added at a later date. Teledyne e2v HiRel Electronics reserves the right to change specifications at any time without notice in order to supply the best possible product.

Product Specification

The data sheet contains final data. In the event Teledyne e2v HiRel Electronics decides to change the specifications, Teledyne e2v HiRel Electronics will notify customers of the intended changes by issuing a CNF (Customer Notification Form).

Sales Contact

For additional information, Email us at: **hirel@teledyne.com** **website: www.tdehirel.com**

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