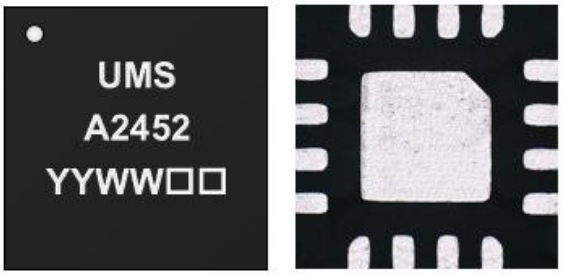
31-43GHz Low Noise Amplifier

GaAs Monolithic Microwave IC in QFN Plastic package

Description

The CHA2452-QAG is a two-stage GaAs Low Noise Amplifier operating over the 31 – 43GHz frequency band. This LNA typically presents a low Noise Figure of 1.8dB associated to a small signal Gain of 24dB.
It provides up to 8dBm output power at 1dB gain compression under a low driving voltage of VD=2.5V and a low quiescent current of 28mA. The linear power can be increased to 15dBm with 5V driving voltage.



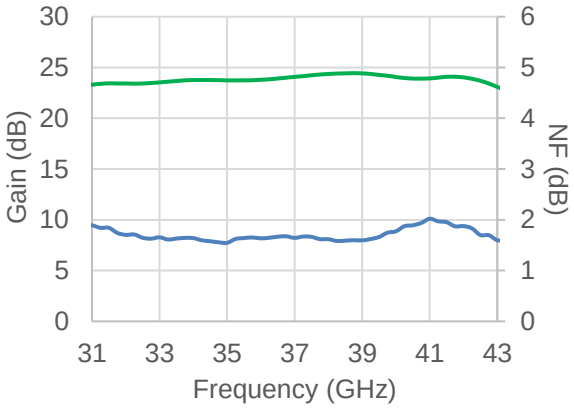
Designed for Telecom applications, it is also ideal for a wide range of microwave systems.

It is available in 3x3 QFN plastic package.

Main Features

- Frequency range: 31-43GHz
- Noise Figure : 1.8dB
- Linear Gain : 24dB
- Biasing conditions:
  - VD=2.5V
  - Idq=28mA
- P1dB : 8dBm @ VD=2.5V
- P1dB : 15dBm @ VD=5V
- 16L-QFN Plastic Package 3x3 mm²
- MSL1

Small Signal Gain and Noise Figure for VD=2.5V & Idq=28mA @ 25°C



Main Electrical Characteristics

Tcase = +25°C, VD=2.5V and Idq=28mA (Tcase: QFN backside temperature)

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	31		43	GHz
Gain	Linear Gain		24		dB
NF	Noise Figure		1.8		dB

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Electrical Characteristics

Tcase = +25°C, VD=2.5V and Idq=28mA

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	31		43	GHz
Gain	Small signal Gain		24		dB
NF	Noise Figure		1.8		dB
|S11|	Input Return loss		10		dB
|S22|	Output return loss		10		dB
OP1dB	Output Power at 1dB gain compression		8		dBm
OIP3	Output Third Order Intercept Point		18		dBm
IMD3	Third Order Intermodulation (2 tones)		-50		dBc
VD	Drain voltage		2.5		V
Idq	Quiescent Current		28		mA
PDC	DC Power Consumption		70		mW

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

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Absolute Maximum Ratings (1)

Tcase = +25°C

Symbol	Parameter	Values	Unit
VD	Positive quiescent voltage	6	V
VG	Negative quiescent voltage	-2	V
Pin	Maximum peak input power overdrive	18	dBm
Id	Quiescent Drain current	70	mA

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

Recommended Operating Range (2), (3), (4)

Symbol	Parameter	Values	Unit
VD	Drain bias voltage	2.0 – 6	V
VG	Gate bias voltage	-1.5 – 0.3	V
Pin	Maximum peak input power overdrive (2)	0	dBm
$T_{junction}$	Junction temperature (4)	175	°C

(2) Electrical performance is defined for specified test conditions

(3) Electrical performance is not guaranteed over all recommended operating conditions

(4) See Device Thermal Performance section

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	6	Vg	-50 to 50	mV
VD	7 & 14	Vdd	2.0 to 5	V

“Power ON” sequence

1. Set the gate Voltage (VG) to -1.5V
2. Apply VD bias voltage to = 2.5V
3. Increase Vg up to quiescent bias drain current Idq=28mA (Vg around 0V)
4. 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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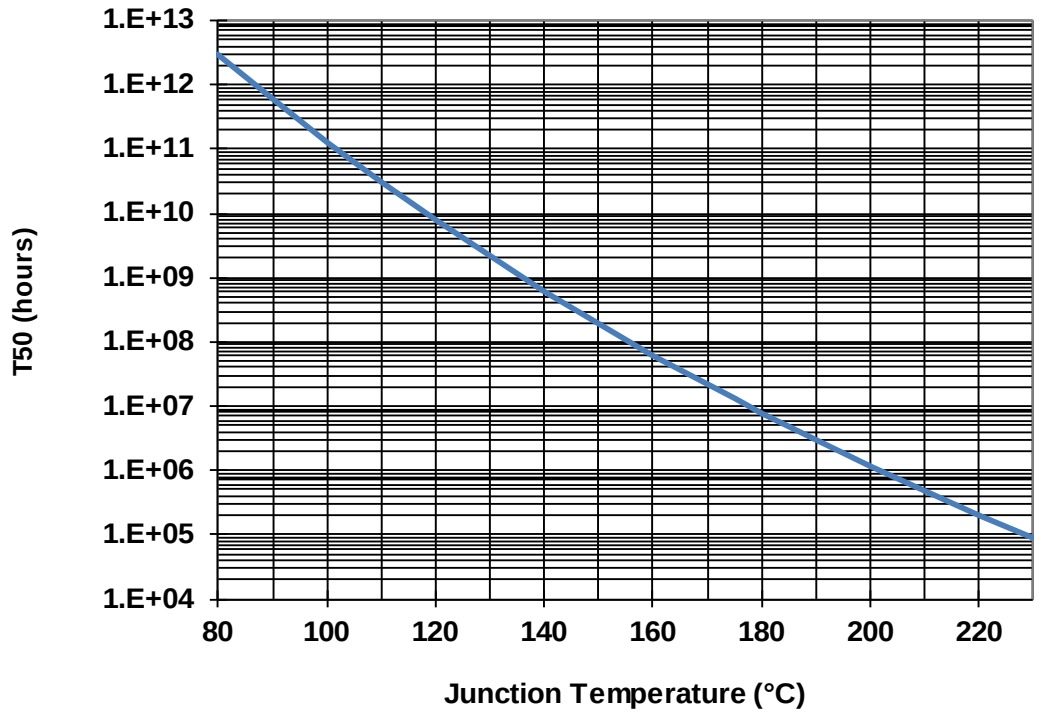
Device thermal performance

All the figures given in this section are obtained assuming that the die is only cooled down by conduction through the package thermal pad.
The temperature is monitored at the QFN backside interface (Tcase).
For nominal operation, the system's maximum temperature must be adjusted to ensure that the junction temperature ($T_{junction}$) remains below the maximum value specified in the Recommended Operating Ratings table.
The system PCB must be designed to comply with this requirement.

Parameter	Biasing conditions	Tjunction (°C)	R_{TH} (°C/W)	T50[2] (hours)
R_{TH} [1] Thermal Resistance (Junction to Case)	VD= 2.5 V Pdiss= 32 mW	91	188	5E+11
	VD= 3 V Pdiss= 42 mW	93	190	4E+11

[1] Assuming 85°C Tcase

[2] The time at which 50% of the products are expected to have failed or reached the end of their useful life.



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Typical Package Sij parameters

Tcase = +25°C, VD=2.5V and Idq=28mA

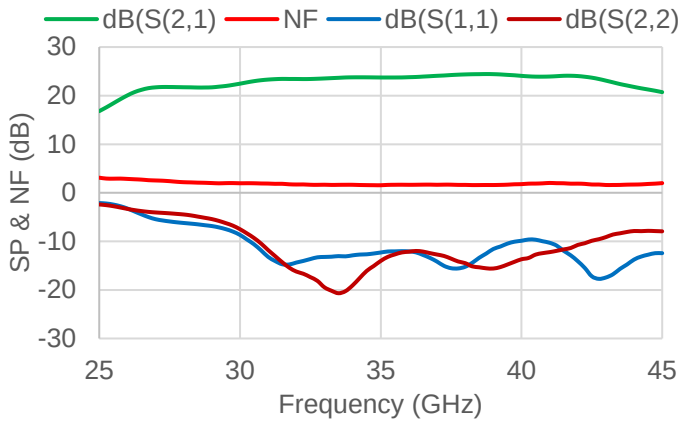
Freq (GHz)	S11 (dB)	PhS11 (°)	S21 (dB)	PhS21 (°)	S12 (dB)	PhS12 (°)	S22 (dB)	PhS22 (°)
26	-3.25	-147.96	20.04	159.67	-53.00	69.58	-3.32	-169.3
26.5	-4.45	140.13	21.19	88.76	-46.94	4.69	-3.77	125.83
27	-5.44	63.59	21.70	17.68	-43.67	-61.42	-4.05	62.96
27.5	-5.90	-10.38	21.77	-51.40	-42.58	-123.75	-4.23	4.17
28	-6.22	-79.30	21.72	-118.07	-41.91	169.55	-4.46	-51.72
28.5	-6.50	-142.90	21.66	176.97	-42.13	109.87	-4.90	-107.75
29	-6.85	158.41	21.70	113.78	-41.77	51.76	-5.42	-163.40
29.5	-7.50	102.98	21.99	51.15	-41.04	-9.89	-6.26	141.69
30	-8.68	49.45	22.45	-12.26	-39.94	-67.84	-7.50	88.38
30.5	-10.61	-4.258	22.97	-77.20	-39.55	-125.93	-9.32	34.17
31	-13.19	-62.94	23.30	-143.20	-39.35	166.91	-11.79	-22.01
31.5	-14.71	-128.68	23.43	150.99	-39.96	102.65	-14.29	-85.33
32	-14.37	166.16	23.42	86.18	-40.58	43.81	-16.22	-153.2
32.5	-13.64	110.97	23.42	22.53	-40.31	-14.21	-17.36	147.12
33	-13.21	65.43	23.53	-41.10	-40.82	-77.51	-19.46	101.12
33.5	-13.04	24.23	23.66	-105.29	-41.59	-133.78	-20.68	79.92
34	-12.88	-16.63	23.76	-169.89	-41.48	166.59	-19.07	59.13
34.5	-12.67	-60.58	23.76	125.72	-42.73	108.06	-16.09	24.76
35	-12.30	-107.05	23.73	61.97	-45.08	48.93	-14.03	-20.82
35.5	-12.06	-153.47	23.73	-1.12	-46.05	-14.12	-12.7	-71.40
36	-12.07	155.72	23.79	-64.21	-46.51	-67.960	-12.138	-125.68
36.5	-12.80	103.25	23.91	-127.74	-45.03	-120.66	-12.11	-177.86
37	-14.17	45.95	24.07	168.24	-48.30	175.64	-12.71	130.30
37.5	-15.53	-18.06	24.23	103.82	-50.10	116.32	-13.56	78.14
38	-15.24	-84.62	24.36	38.87	-54.29	44.55	-14.48	22.42
38.5	-13.38	-143.26	24.42	-26.46	-49.61	-58.37	-15.34	-36.91
39	-11.57	167.74	24.41	-92.10	-58.29	-121.82	-15.59	-98.24
39.5	-10.47	124.55	24.26	-157.55	-54.05	-179.84	-14.78	-154.9
40	-9.88	84.12	24.06	137.23	-55.19	76.49	-13.69	161.26
40.5	-9.66	42.36	23.90	73.01	-53.05	23.10	-12.73	121.51
41	-10.29	-2.25	23.92	8.40	-58.38	-67.86	-12.22	84.54
41.5	-11.95	-49.16	24.08	-57.21	-50.28	-109.35	-11.66	47.56
42	-14.07	-105.39	24.02	-125.34	-51.33	-157.08	-10.74	3.04
42.5	-17.19	-176.97	23.69	166.38	-49.11	150.96	-9.88	-48.01
43	-17.44	103.38	23.08	98.56	-52.58	94.66	-9.12	-102.8
43.5	-15.67	32.75	22.38	32.65	-48.49	5.75	-8.35	-158.4
44	-13.75	-25.76	21.78	-32.39	-51.12	-72.58	-7.87	146.26
44.5	-12.75	-73.56	21.26	-97.77	-51.93	-105.41	-7.83	89.67
45	-12.43	-111.49	20.71	-163.73	-50.30	-157.47	-7.94	28.42

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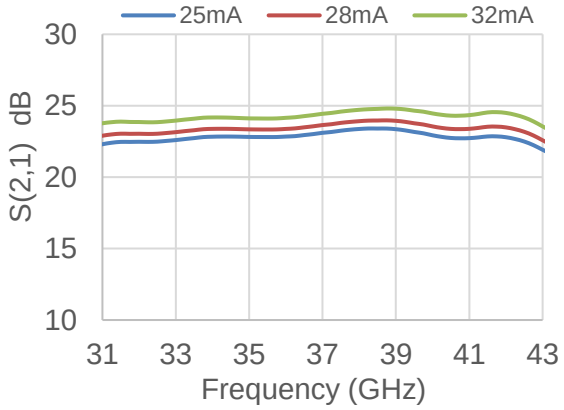
Typical Board Measurements

Board losses are de-embedded. Measurements are given in the package reference planes.
Test conditions : CW, T_{case} = 25°C, VD = 2V , Id=25mA/28mA/32mA

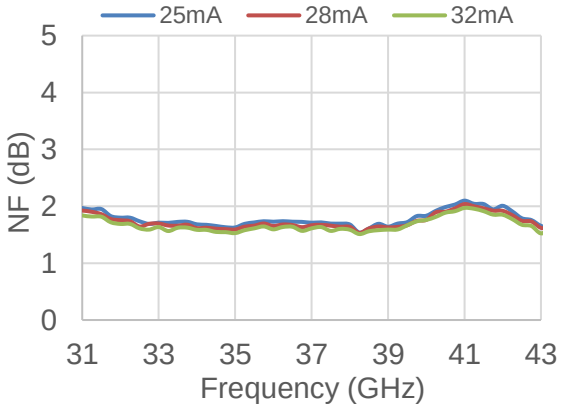
Wideband S-parameters and Noise Figure for VD=2.0V and Idq=28mA



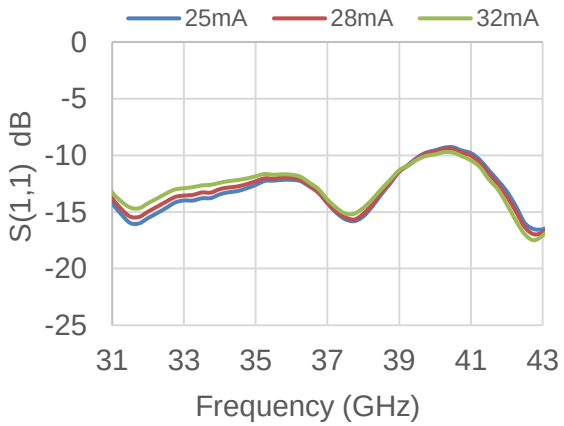
Linear Gain vs. Frequency and Bias



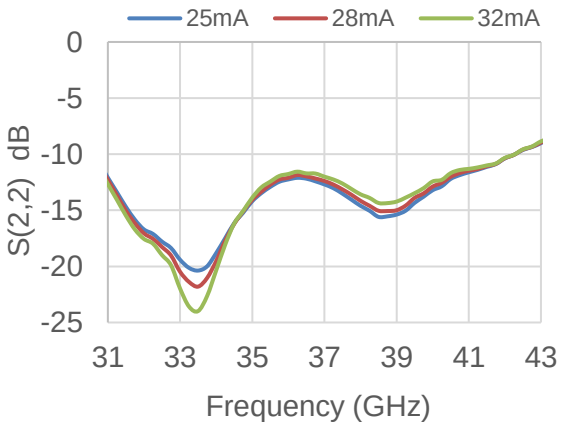
Noise Figure vs. Frequency and Bias



Input Return Loss vs. Frequency and Bias



Output Return Loss vs. Frequency and Bias



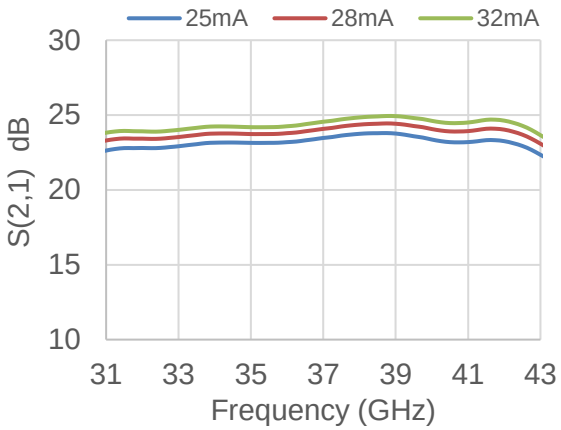
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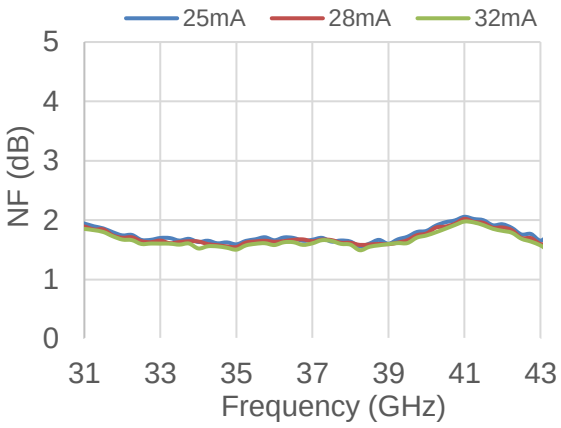
Typical Board Measurements

Board losses are de-embedded. Measurements are given in the package reference planes.
Test conditions : CW, T_{case} = 25°C, VD = 2.5V , Id=25mA/28mA/32mA

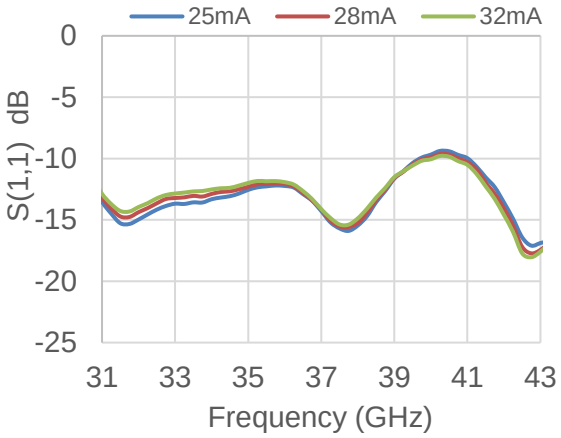
Linear Gain vs. frequency and bias



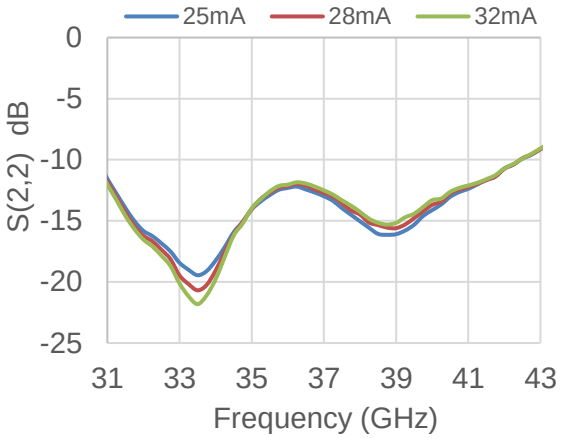
Noise Figure vs. frequency and bias



Input return loss vs. frequency and bias



Output return loss vs. frequency and bias

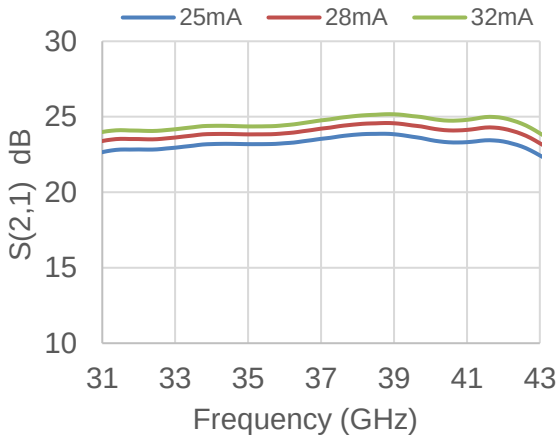


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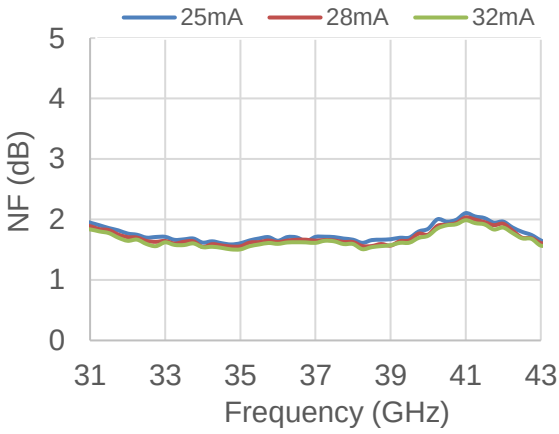
Typical Board Measurements

Board losses are de-embedded. Measurements are given in the package reference planes.
Test conditions : CW, T_{case} = 25°C, VD = 3V , Id=25mA/28mA/32mA

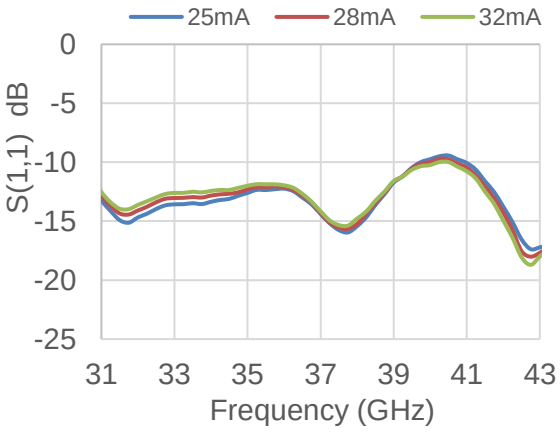
Linear Gain vs. frequency and bias



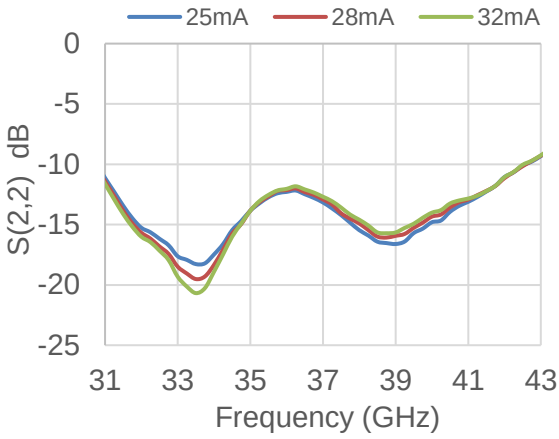
Noise Figure vs. frequency and bias



Input return loss vs. frequency vs. bias



Output return loss vs. frequency vs. bias

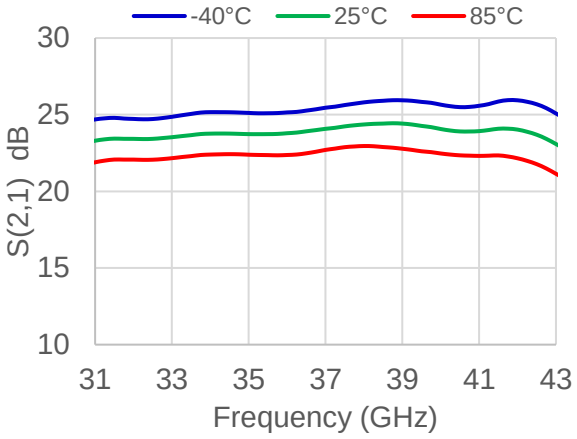


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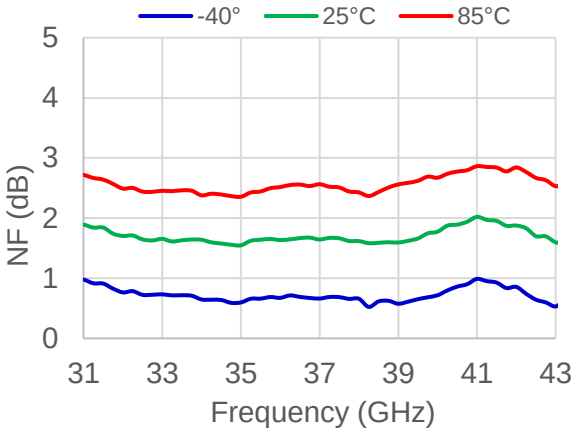
Typical Board Measurements

Board losses are de-embedded. Measurements are given in the package reference planes.
Test conditions : CW, T_{case} = -40°C/25°C/85°C, VD = 2.5V, Idq=28mA

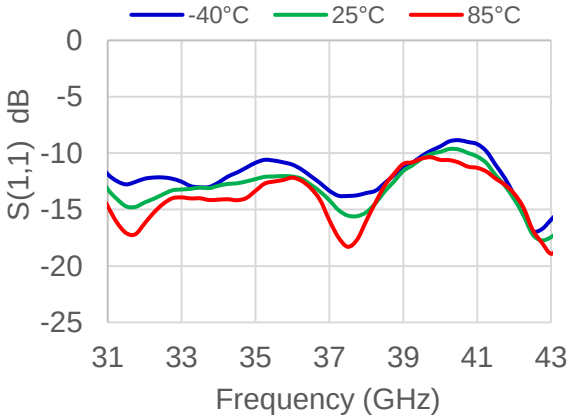
Linear Gain vs. frequency and temperature



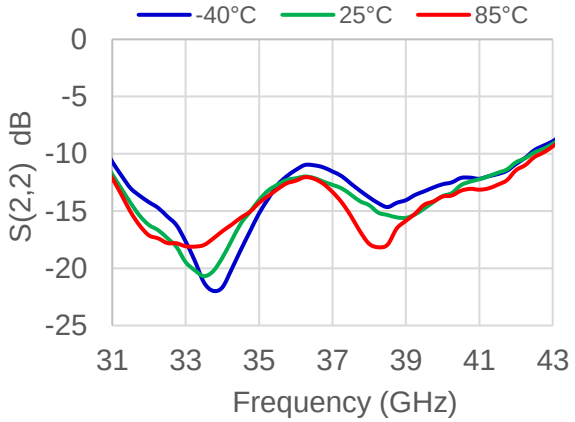
Noise Figure vs. frequency and temperature



Input Return Loss vs. frequency and temperature



Output Return Loss vs. frequency and temperature

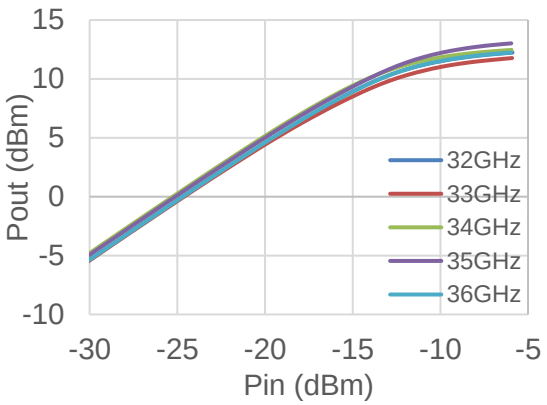


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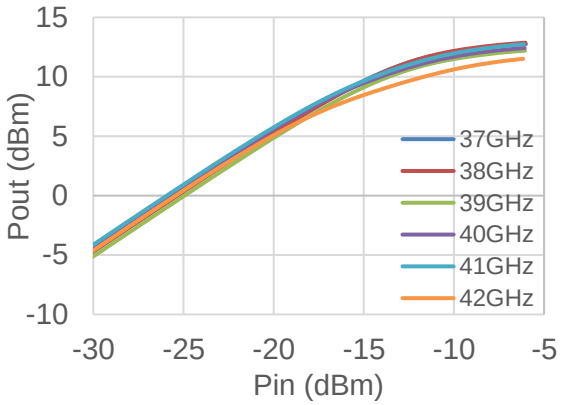
Typical Board Measurements

Board losses are de-embedded. Measurements are given in the package reference planes.
Test conditions : CW, T_{case} = -40°C/25°C/85°C, VD =2.5V, Idq=28mA

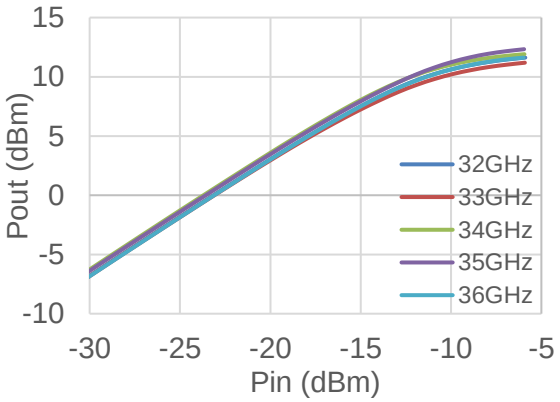
Output Power vs. Input Power @ -40°C



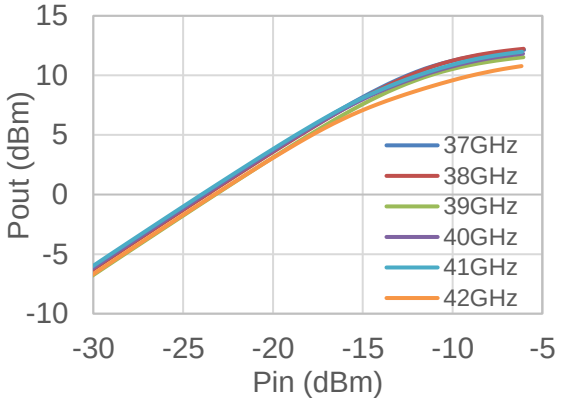
Output Power vs. Input Power@ -40°C



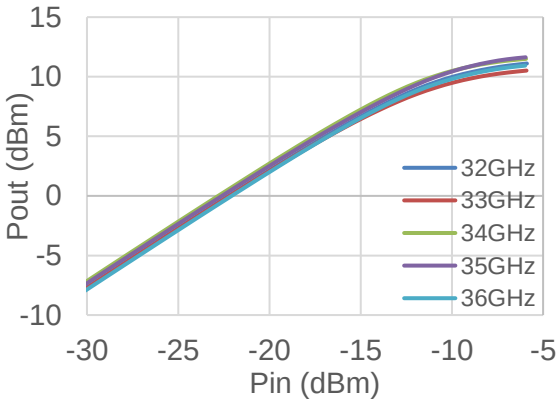
Output Power vs. Input Power @ 25°C



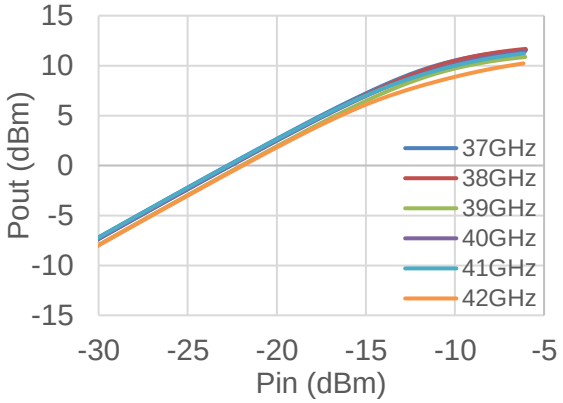
Output Power vs. Input Power @ 25°C



Output Power vs. Input Power @ 85°C



Output Power vs. Input Power @ 85°C

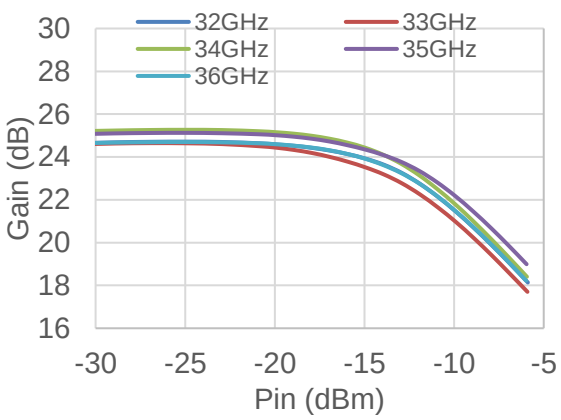


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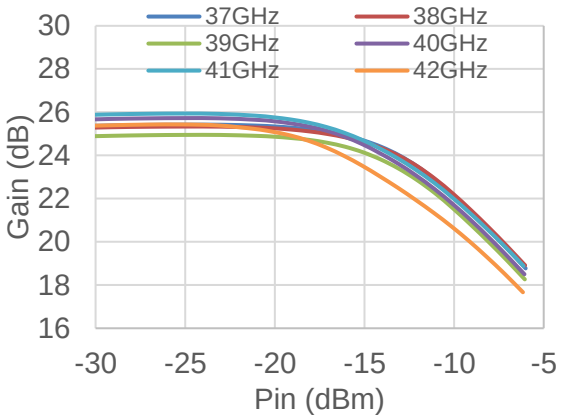
Typical Board Measurements

Board losses are de-embedded. Measurements are given in the package reference planes.
Test conditions : CW, T_{case} = -40°C/25°C/85°C, VD =2.5V, Idq=28mA

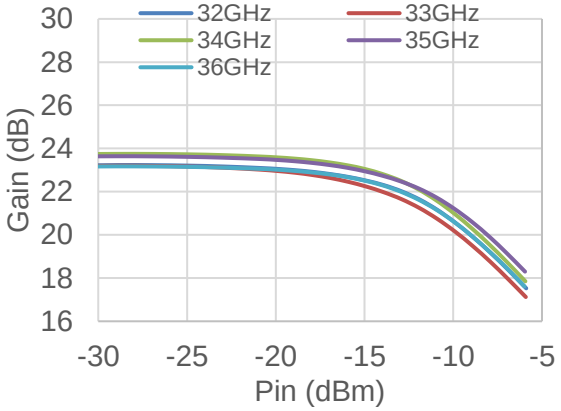
Gain Power vs. Input Power @ -40°C



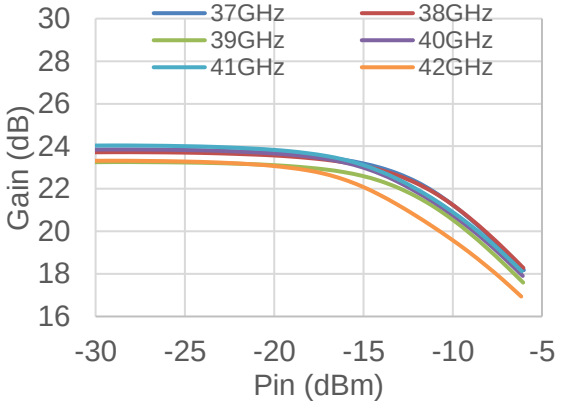
Gain Power vs. Input Power@ -40°C



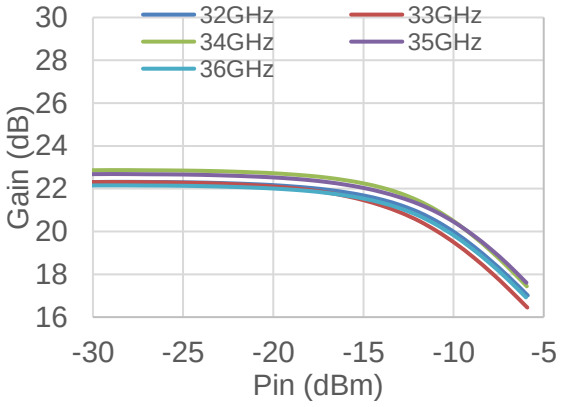
Gain Power vs. Input Power @ 25°C



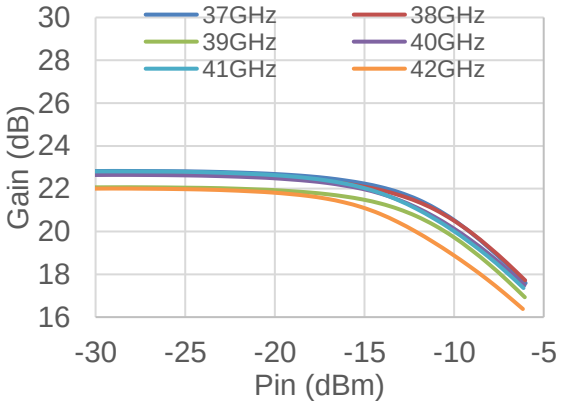
Gain Power vs. Input Power @ 25°C



Gain Power vs. Input Power @ 85°C



Gain Power vs. Input Power @ 85°C

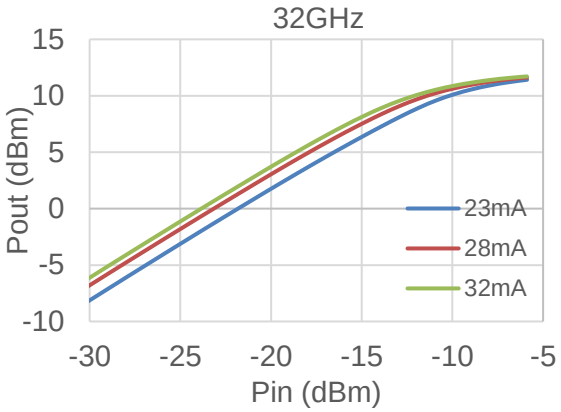


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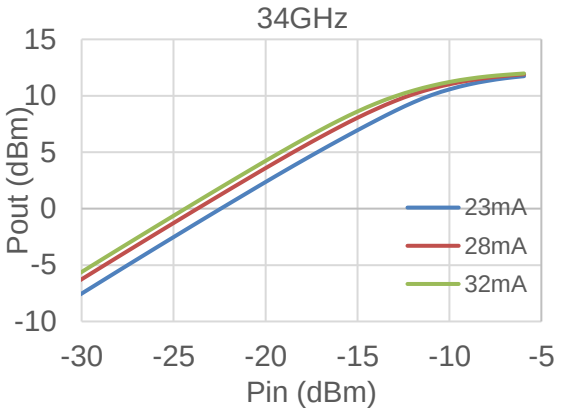
Typical Board Measurements

Board losses are de-embedded. Measurements are given in the package reference planes.
Test conditions : CW, T_{case} = 25°C, VD =2.5V, Idq=23mA/28mA/32mA

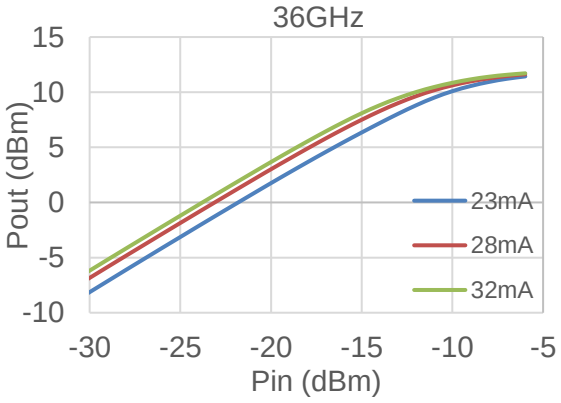
Output Power vs. Input Power @ 25°C



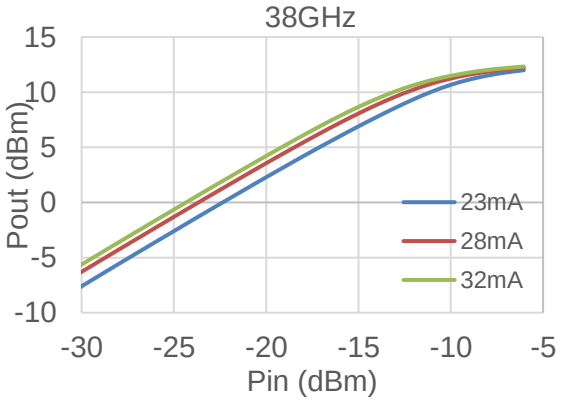
Output Power vs. Input Power@ 25°C



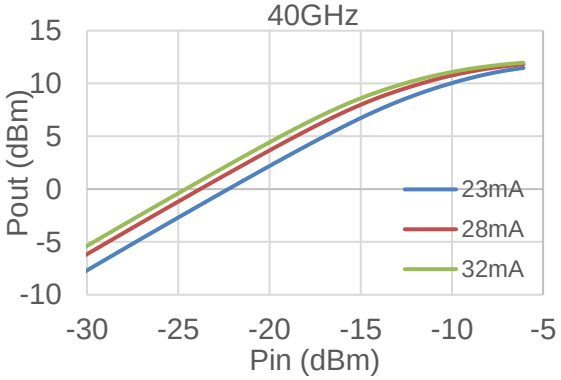
Output Power vs. Input Power @ 25°C



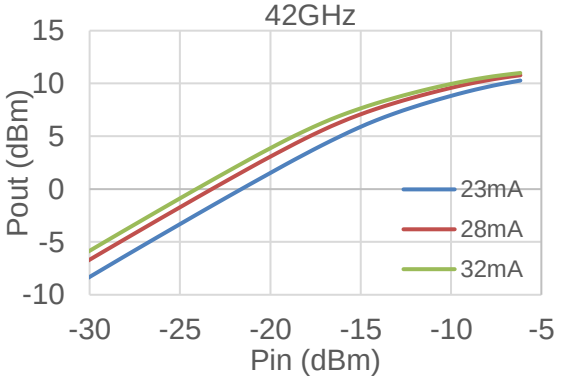
Output Power vs. Input Power @ 25°C



Output Power vs. Input Power @ 25°C



Output Power vs. Input Power @ 25°C

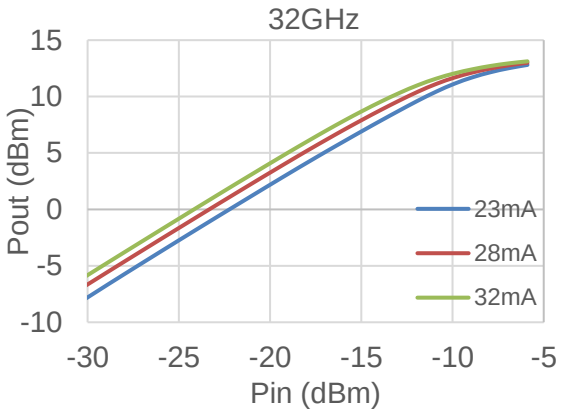


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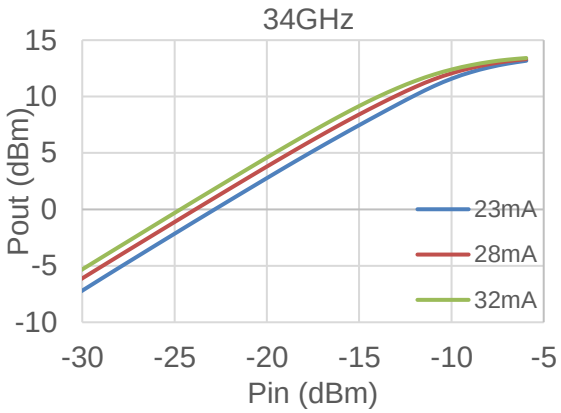
Typical Board Measurements

Board losses are de-embedded. Measurements are given in the package reference planes.
Test conditions : CW, T_{case} = 25°C, VD =3V, Idq=23mA/28mA/32mA

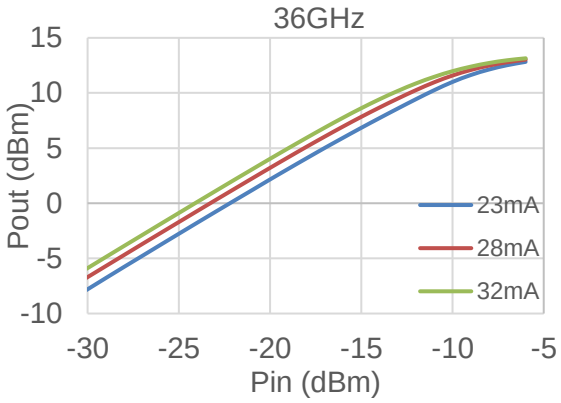
Output Power vs. Input Power @ 25°C



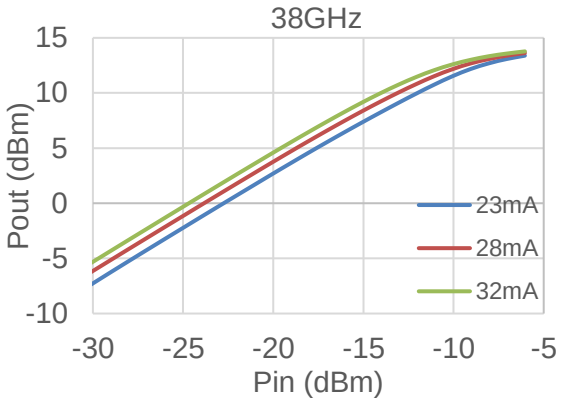
Output Power vs. Input Power@ 25°C



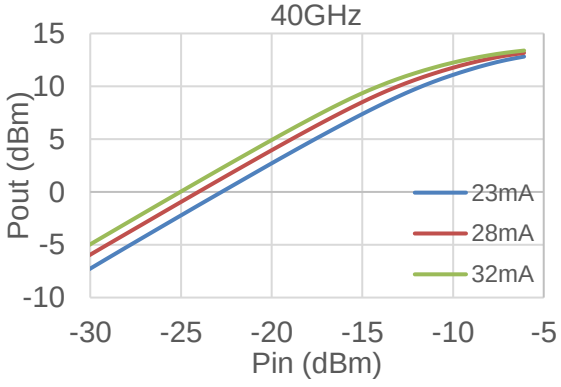
Output Power vs. Input Power @ 25°C



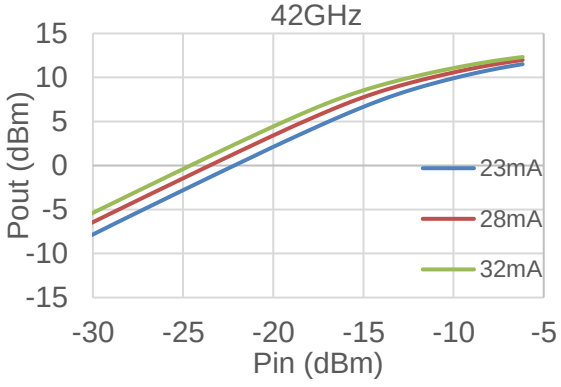
Output Power vs. Input Power @ 25°C



Output Power vs. Input Power @ 25°C



Output Power vs. Input Power @ 25°C

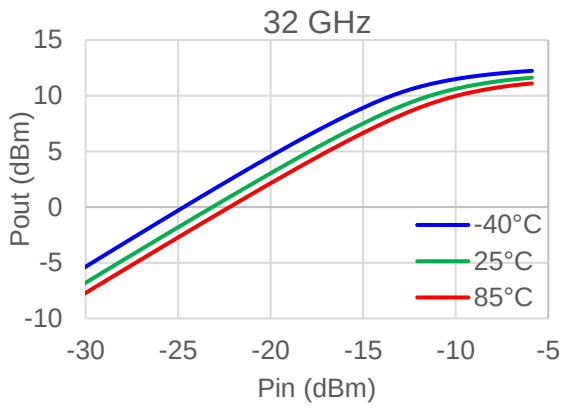


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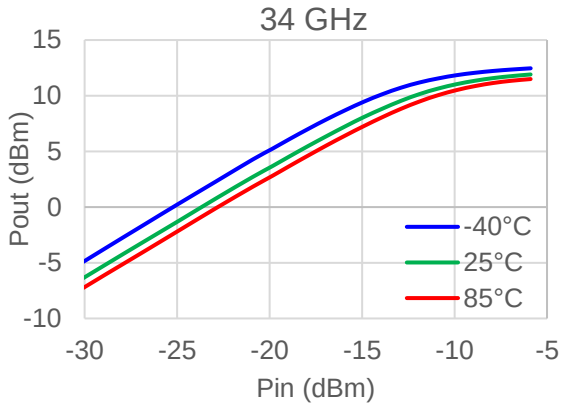
Typical Board Measurements

Board losses are de-embedded. Measurements are given in the package reference planes.
Test conditions : CW, T_{case} = -40°C/25°C/85°C, VD =2.5V, Idq=28mA

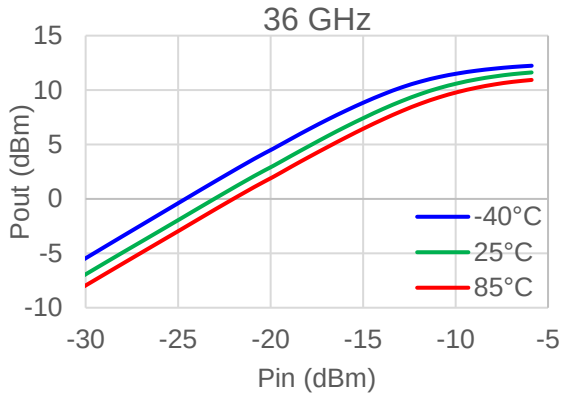
Output Power vs. Input Power @ 32GHz



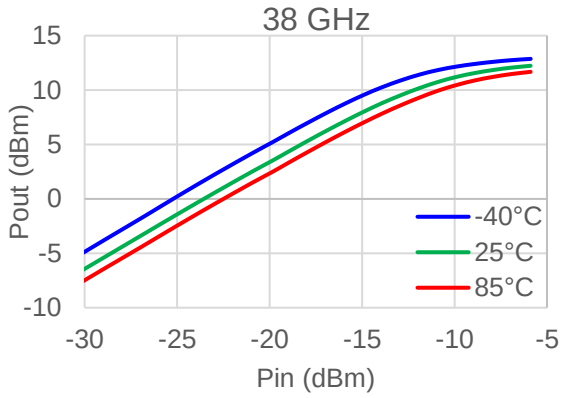
Output Power vs. Input Power@ 34GHz



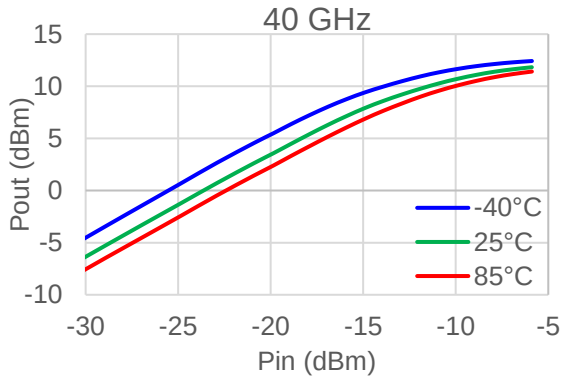
Output Power vs. Input Power @ 36GHz



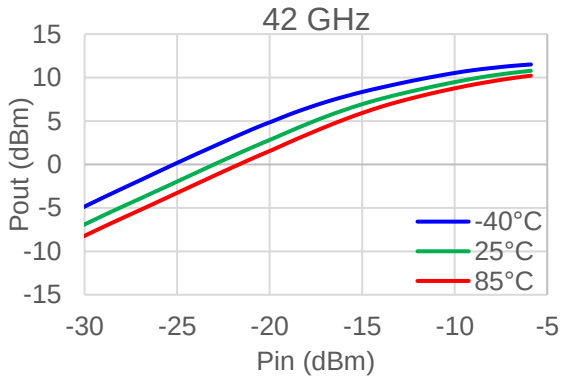
Output Power vs. Input Power @ 38GHz



Output Power vs. Input Power @ 40GHz



Output Power vs. Input Power @ 42GHz

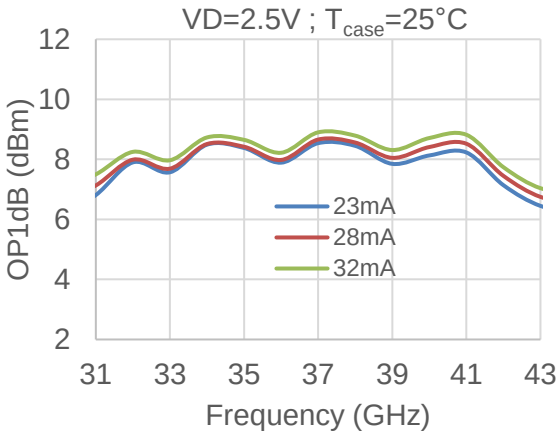


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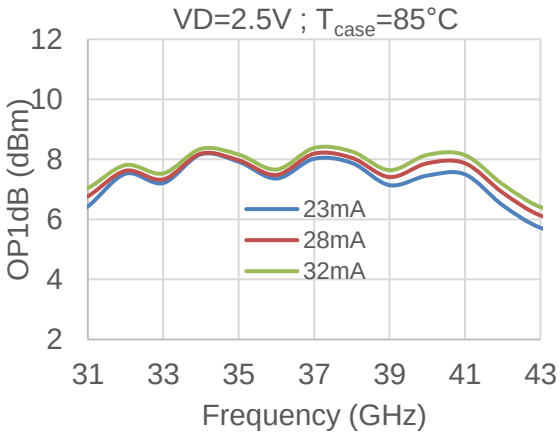
Typical Board Measurements

Board losses are de-embedded. Measurements are given in the package reference planes.
Test conditions : CW, T_{case} = 25°C/85°C, VD=2.5V/3V, Id=23mA/28mA/32mA

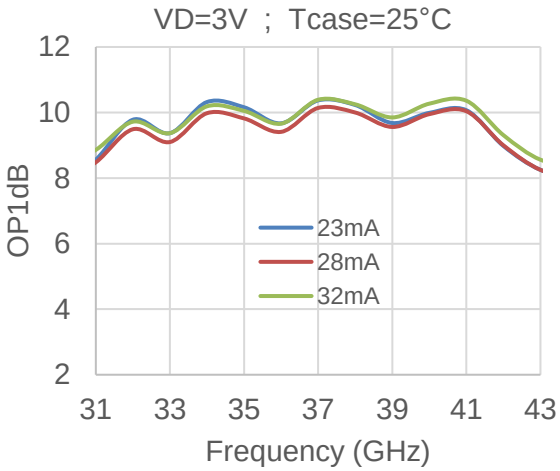
OP1dB vs. frequency @ 25°C and bias



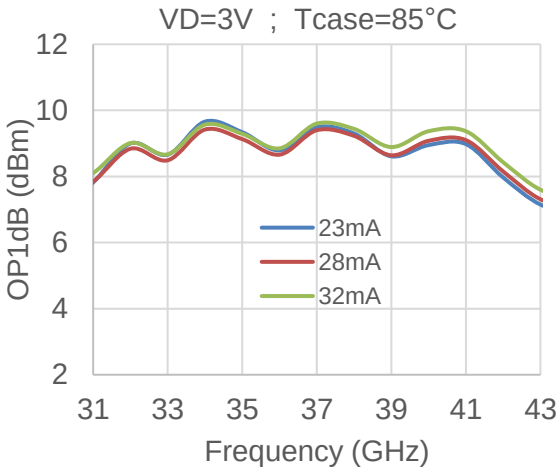
OP1dB vs. frequency @ 85°C and bias



OP1dB vs. frequency @ 25°C and bias



OP1dB vs. frequency @ 85°C and bias

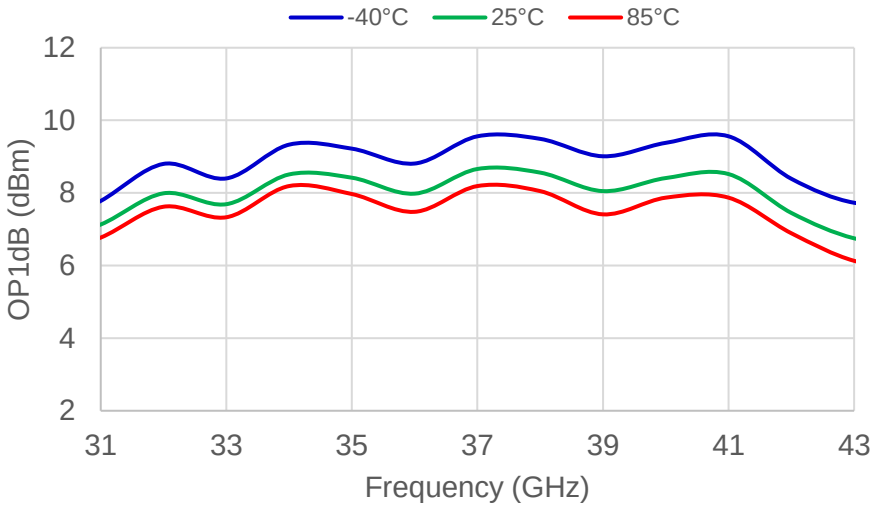


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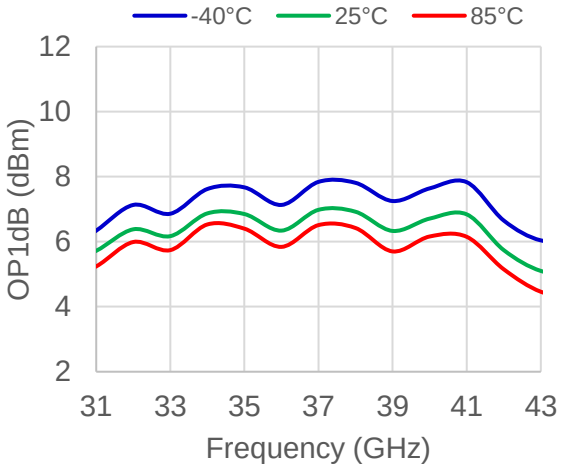
Typical Board Measurements

Board losses are de-embedded. Measurements are given in the package reference planes.
Test conditions : CW, T_{case}=-40°C/25°C/85°C,VD=2V/2.5V/3V, Idq=28mA

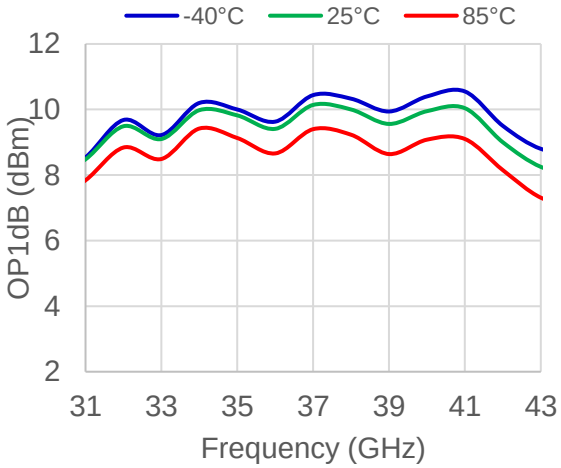
OP1dB vs. frequency vs. temperature @ 2.5V/28mA



OP1dB vs. frequency vs. temperature @2V/28mA



OP1dB vs. frequency vs. temperature @3V/28mA

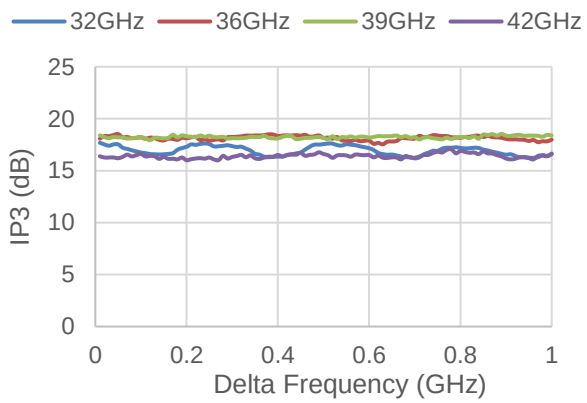


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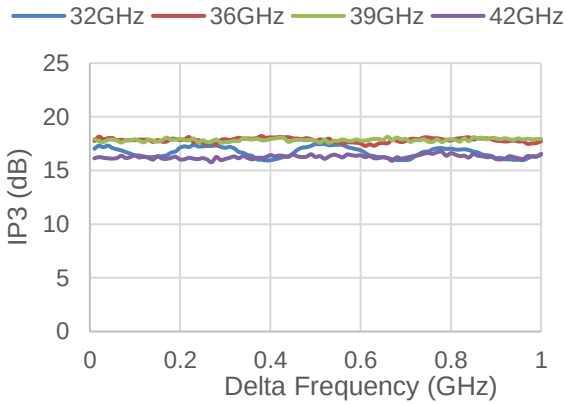
Typical Board Measurements

Measurements are given in the board reference planes.
Test conditions : CW, Tcase = 25°C/85°C, VD=2.5V, Idq=28mA, Pin=-30dBm

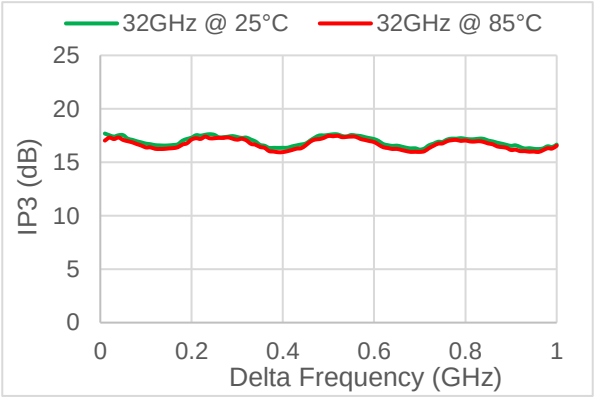
OIP3 vs. Delta Frequency at 25°C



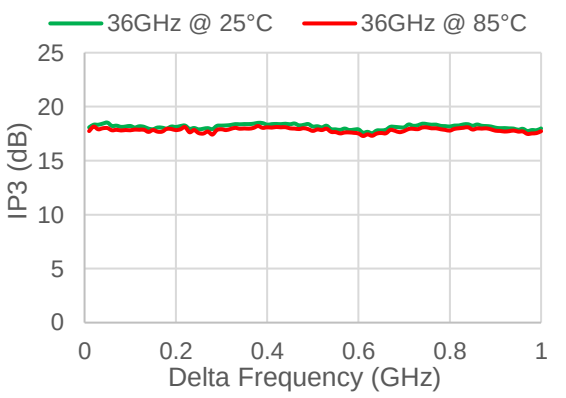
OIP3 vs. Delta Frequency at 85°C



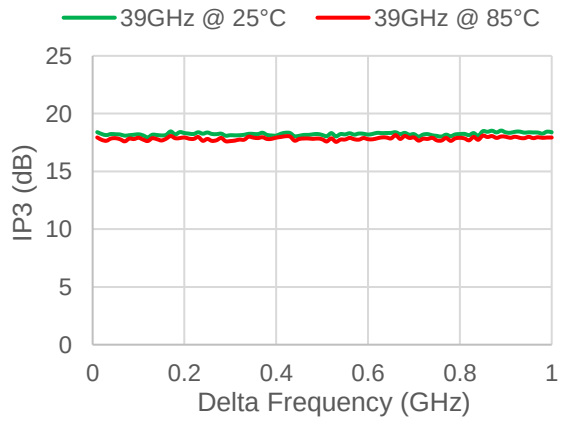
OIP3 vs. Delta Frequency vs. temperature at 32GHz



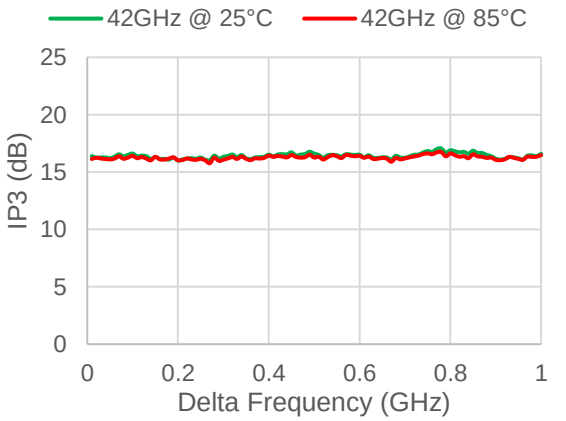
OIP3 vs. Delta Frequency vs. temperature at 36GHz



OIP3 vs. Delta Frequency vs. temperature at 39GHz



OIP3 vs. Delta Frequency vs. temperature at 42GHz

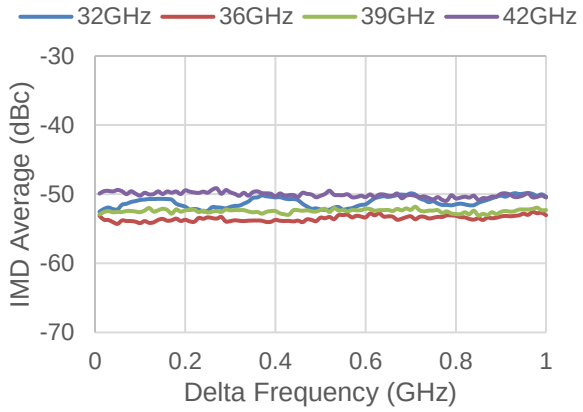


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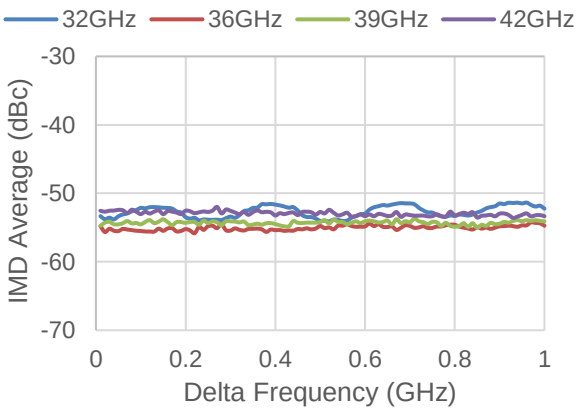
Typical Board Measurements

Measurements are given in the board reference planes.
Test conditions : CW, Tcase = 25°C/85°C, VD=2.5V, Idq=28mA, Pin=-30dBm

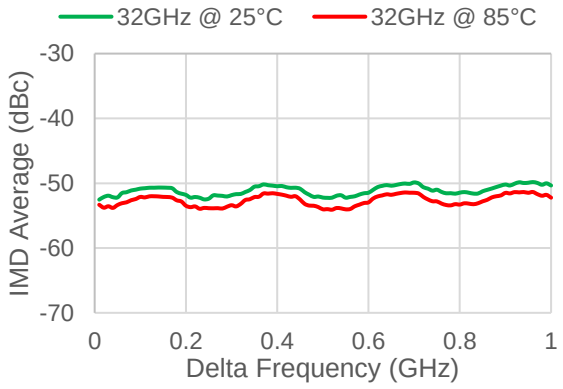
IMD vs. Delta Frequency at 25°C



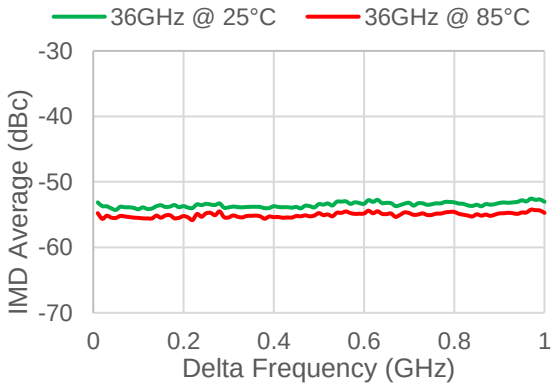
IMD vs. Delta Frequency at 85°C



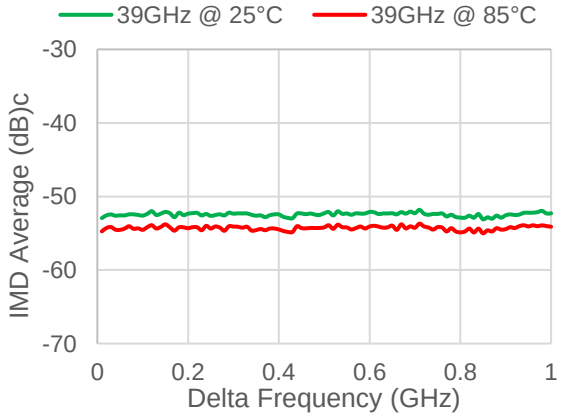
IMD vs. Delta Frequency vs. temperature at 32GHz



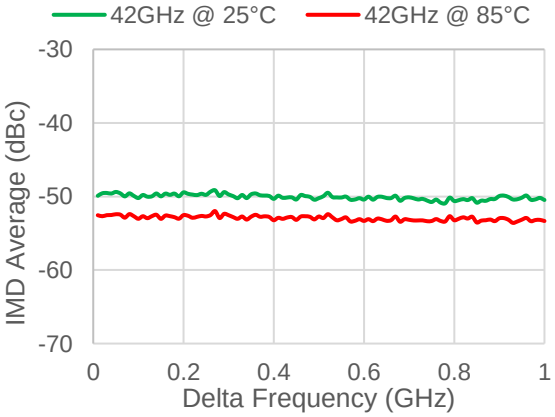
IMD vs. Delta Frequency vs. temperature at 36GHz



IMD vs. Delta Frequency vs. temperature at 39GHz



IMD vs. Delta Frequency vs. temperature at 42GHz

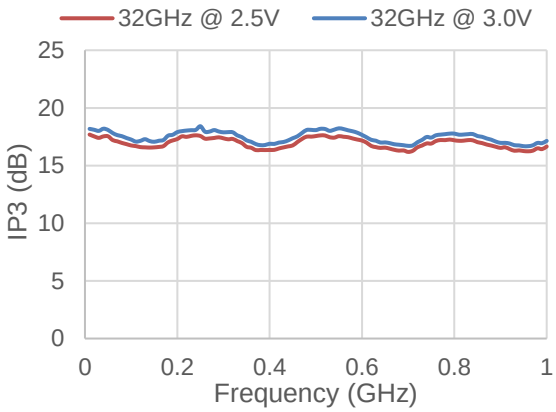


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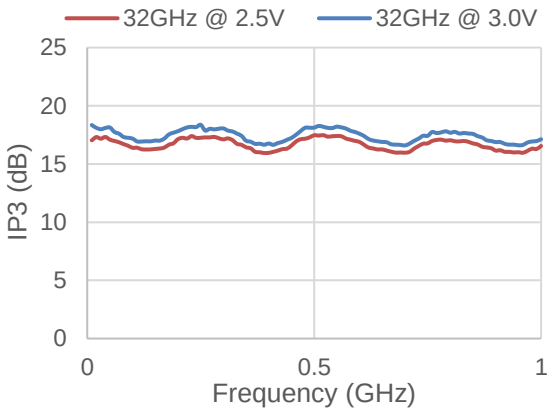
Typical Board Measurements

Measurements are given in the board reference planes.
Test conditions : CW, Tcase = 25°C/85°C, VD=2.5V/3V, Idq=28mA, Pin=-30dBm

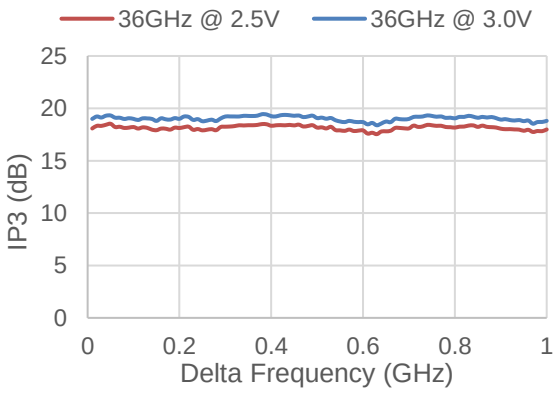
IP3 vs. Delta Frequency vs. VD at 25°C



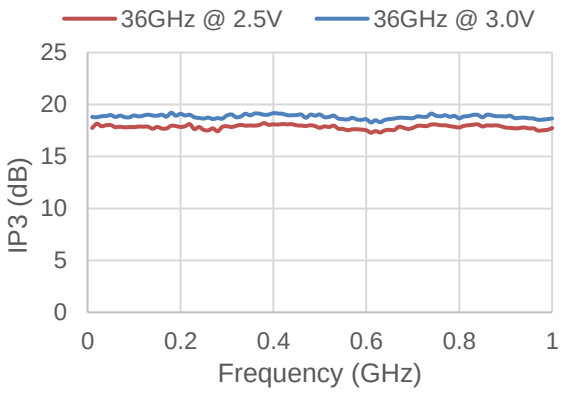
IP3 vs. Delta Frequency vs. VD at 85°C



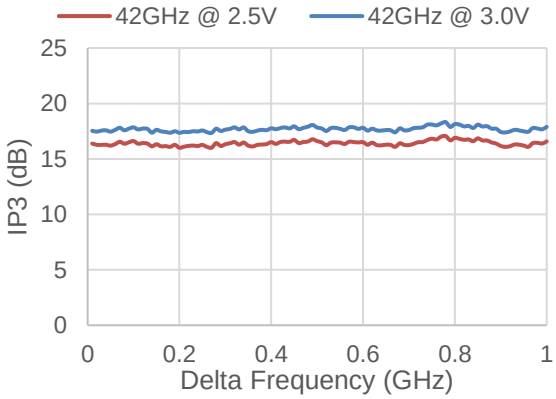
IP3 vs. Delta Frequency vs. VD at 25°C



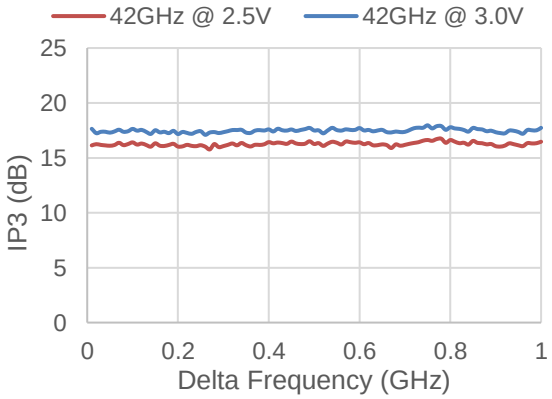
IP3 vs. Delta Frequency vs. VD at 85°C



IP3 vs. Delta Frequency vs. VD at 85°C



IP3 vs. Delta Frequency vs. VD at 85°C

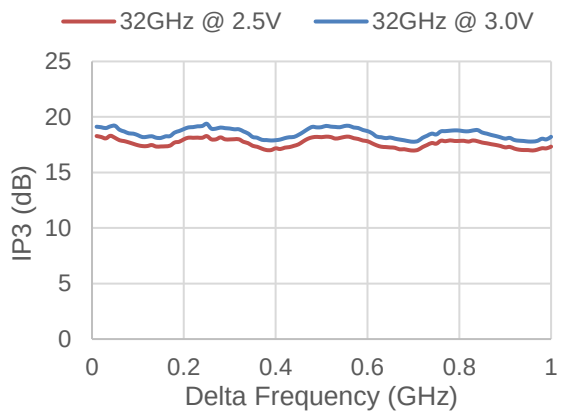


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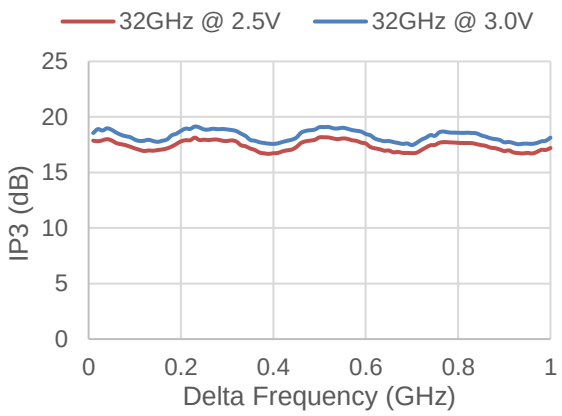
Typical Board Measurements

Measurements are given in the board reference planes.
Test conditions : CW, Tcase = 25°C/85°C, VD=2.5V/3V, Idq=32mA, Pin=-30dBm

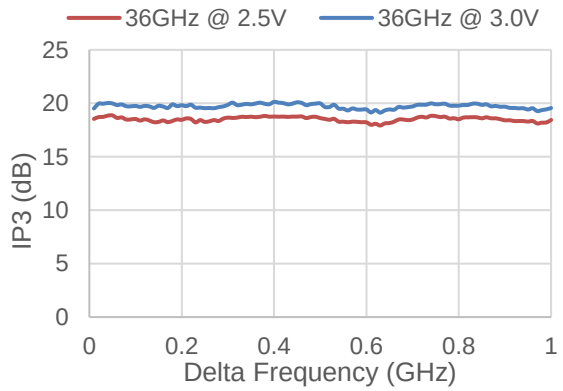
IP3 vs. Delta Frequency vs. VD at 25°C



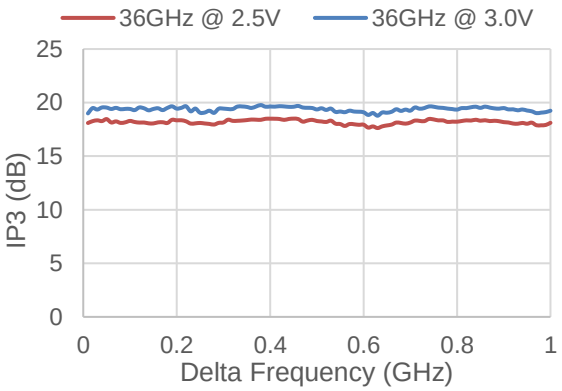
IP3 vs. Delta Frequency vs. VD at 85°C



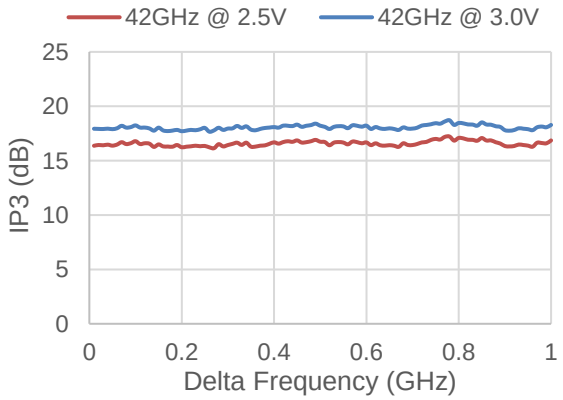
IP3 vs. Delta Frequency vs. VD at 25°C



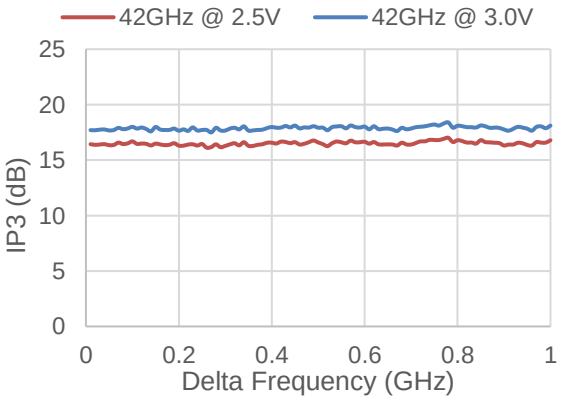
IP3 vs. Delta Frequency vs. VD at 85°C



IP3 vs. Delta Frequency vs. VD at 85°C



IP3 vs. Delta Frequency vs. VD at 85°C

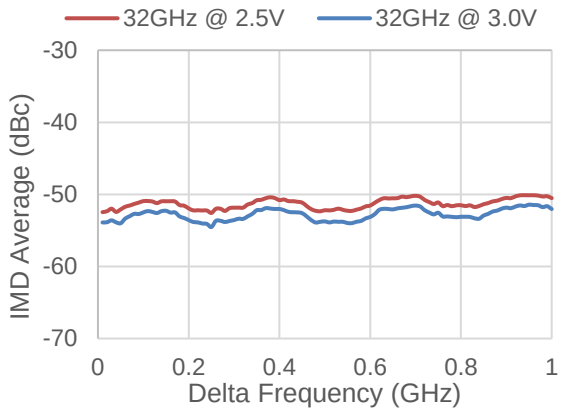


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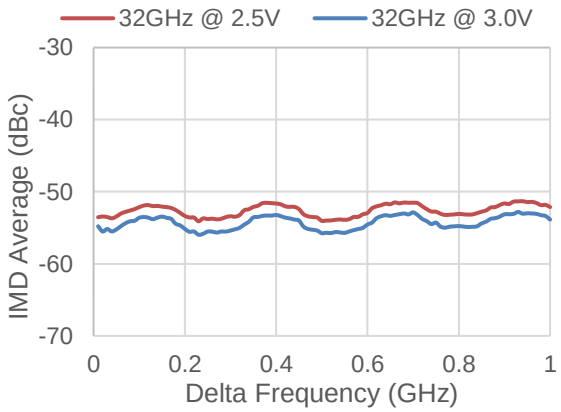
Typical Board Measurements

Measurements are given in the board reference planes.
Test conditions : CW, Tcase = 25°C/85°C, VD=2.5V/3V, Idq=32mA, Pin=-30dBm

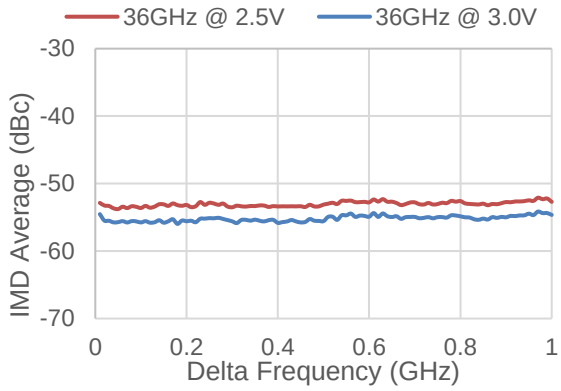
IMD vs. Delta Frequency vs. VD at 25°C



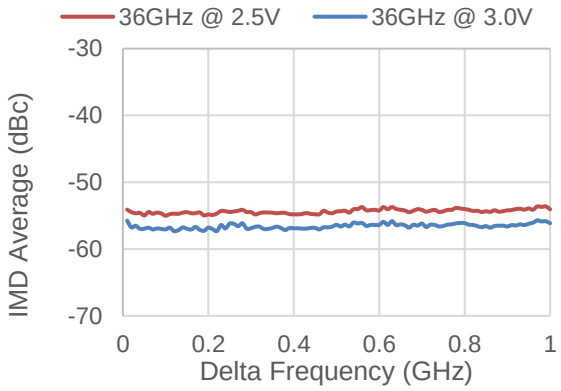
IMD vs. Delta Frequency vs. VD at 85°C



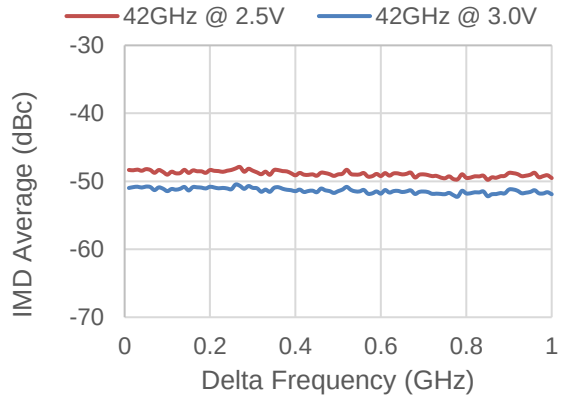
IMD vs. Delta Frequency vs. VD at 25°C



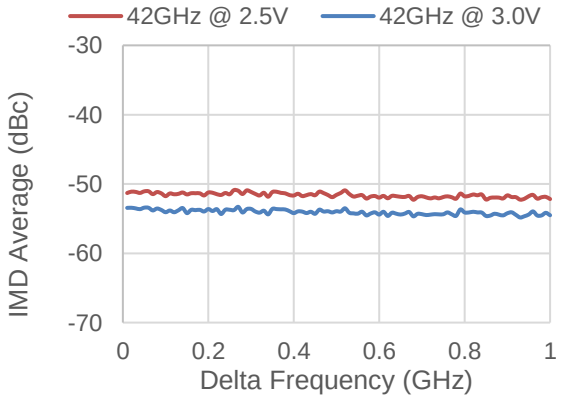
IMD vs. Delta Frequency vs. VD at 85°C



IMD vs. Delta Frequency vs. VD at 85°C

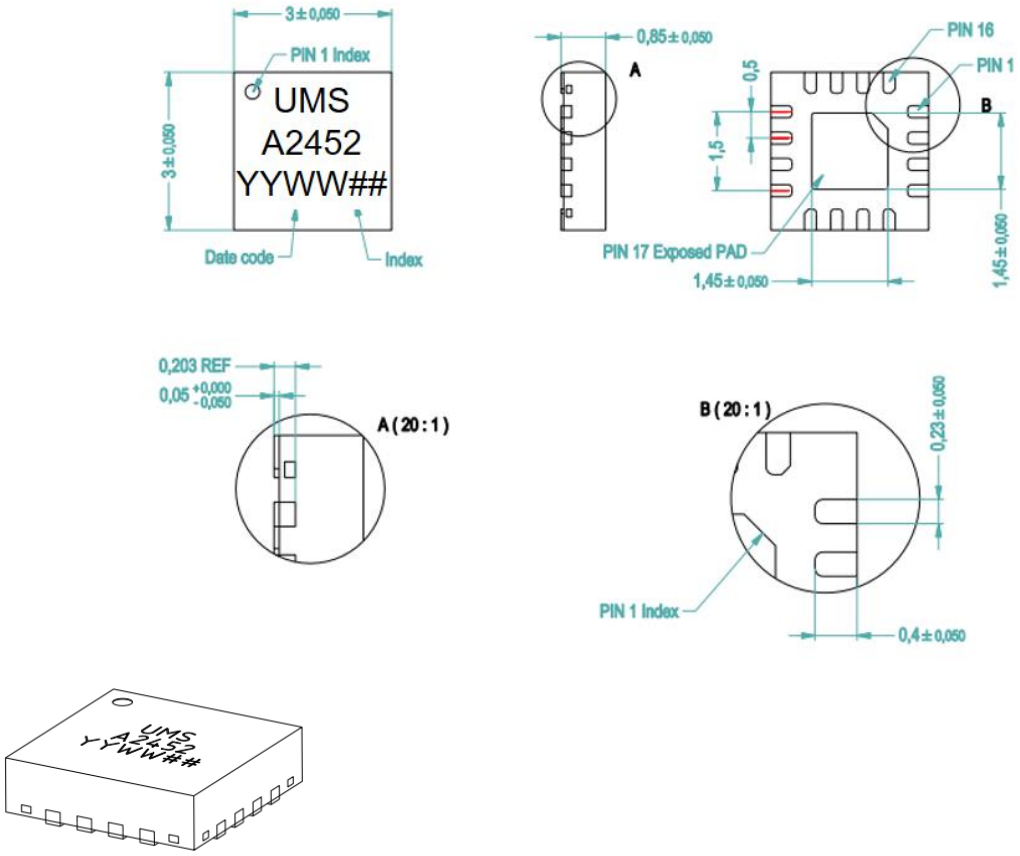


IMD vs. Delta Frequency vs. VD at 85°C



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Package outline (1)



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

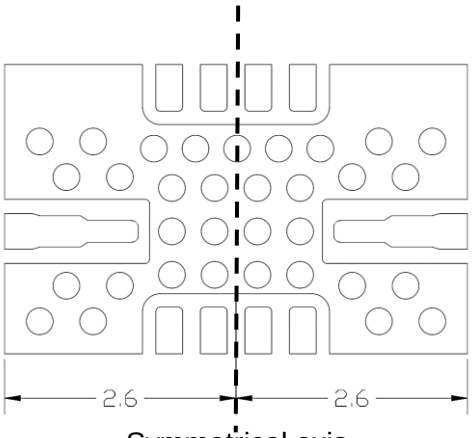
(1) Refer to the application note AN0017 (https://www.ums-rf.com) for general consideration and recommendations for Molded Plastic QFN/DFN packages.

(2) It is strongly recommended to ground all pins marked “GND” through the PCB. Ensure that the PCB 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 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



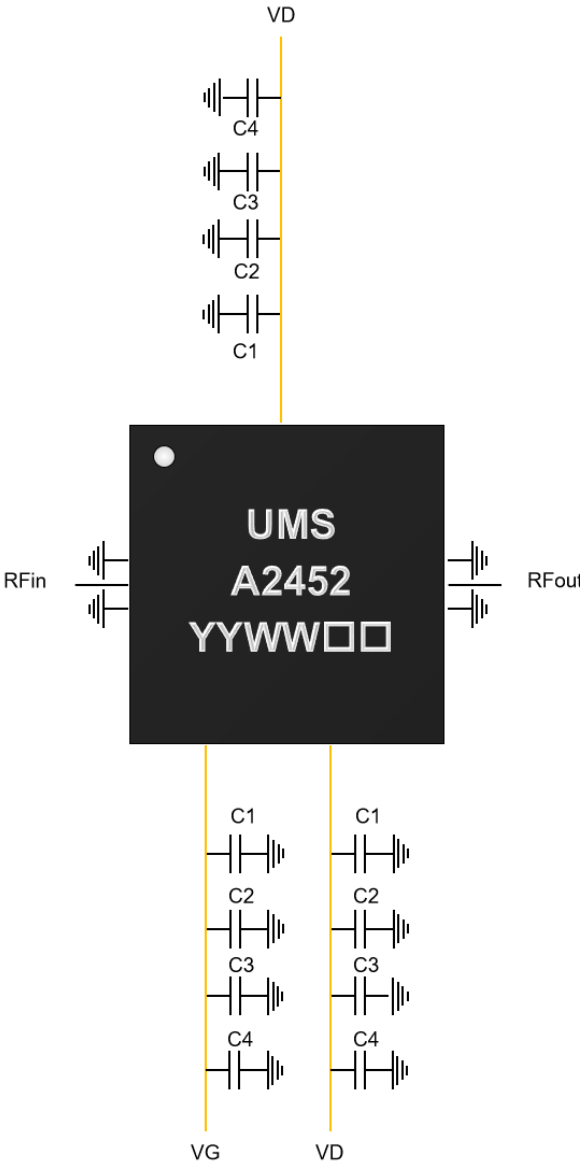
Symmetrical axis

Package Information

Parameter	Value
Package body material	RoHS-compliant
	Low stress Injection Molded Plastic
Lead finish	100% Matt tin
MSL Rating	MSL1

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Recommended assembly plan



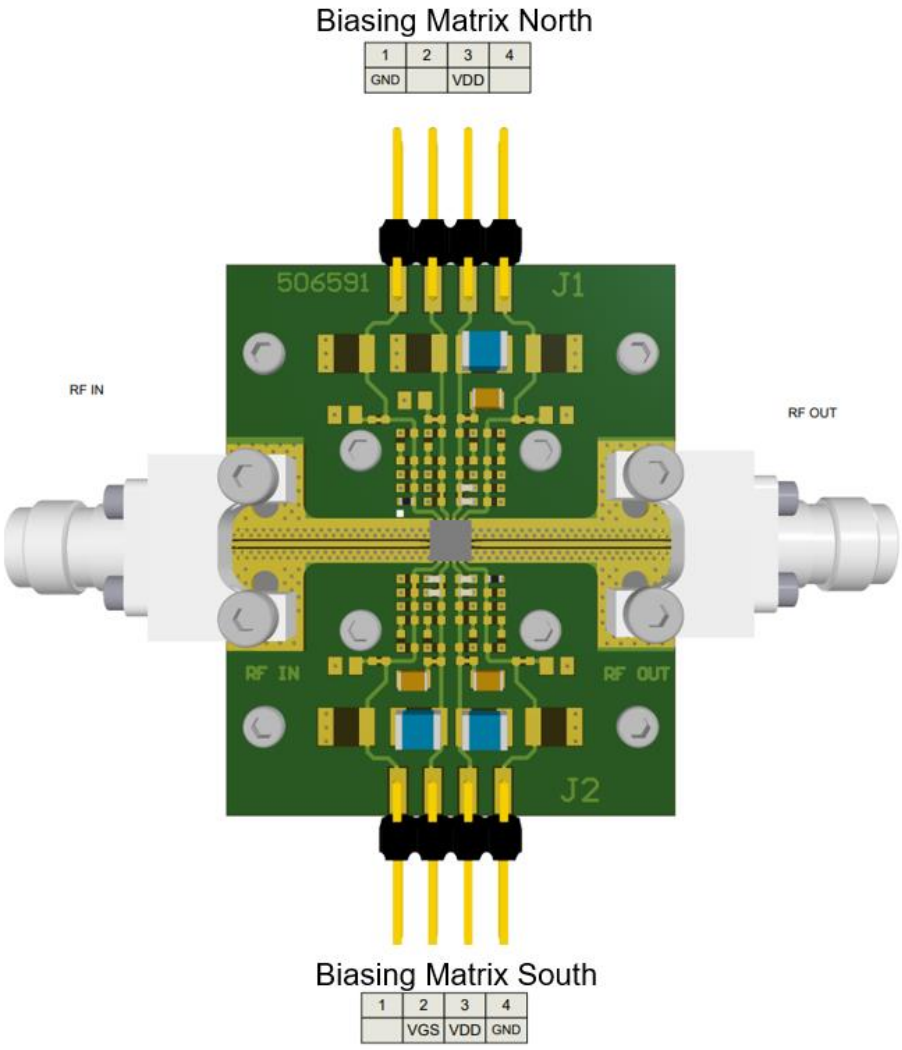
Recommended circuit bonding table

	Label	Value	Description
	C1	120pF	Capacitor 120pF ±15% 20V
	C2	10nF	Capacitor 10nF ±10% 20V
	C3	1µF	Capacitor 1µF ±10% 20V
	C4	10µF	Capacitor 10µF ±10% 20V

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Evaluation board[1]

- 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 120pF, 10nF, 1µF, 10µF ±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.

[1] 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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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 packaged products.

Evaluation Board for Packaged Die

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.

Ordering Information

QFN 3x3 package:	CHA2452-QAG/XY	
	Stick: XY = 20	Tape & reel: XY = 21
Evaluation Board	EVB-CHA2452-QAG	

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