

21-30GHz Medium Power Amplifier

GaAs Monolithic Microwave IC

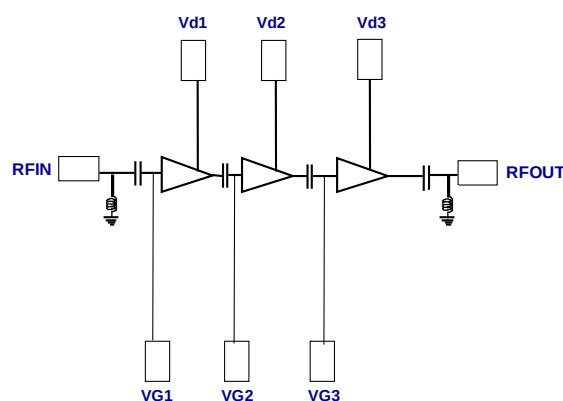
Description

The CHA3395-98F is a 3 stages monolithic Medium Power Amplifier, which produces 24dB gain for 20 dBm output power at 1dB compression.

It is designed for a wide range of applications, from space to commercial communication systems.

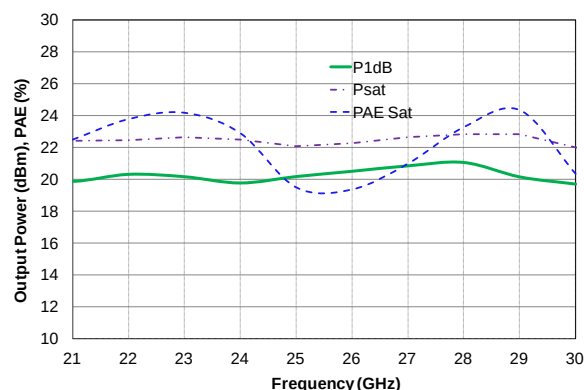
The circuit is manufactured with a pHEMT process, 0.25μm gate length, via holes through the substrate, air bridges and electron beam gate lithography.

It is available in chip form.



Main Features

- Broadband performances: 21-30GHz
- 20dBm Pout at 1dB compression
- 24dB gain
- 32dBm OTOI
- DC bias: Vd= 4.0V, Id= 180mA
- Chip size 1.5x2.5x0.1mm



Main Electrical Characteristics

Tamb.= +25°C

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	21		30	GHz
Gain	Linear Gain		24		dB
P-1dB	Output Power @1dB comp.		20		dBm
OTOI	3 rd order Intercept point		32		dBm

Electrical Characteristics

Tamb.= +25°C, Vd = +4.0V

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	21		30	GHz
Gain	Linear Gain		24.0		dB
ΔG	Gain variation in temperature		0.023		dB/°C
G _{CTRL}	Gain control range		15		dB
OTOI	3 rd order Intercept point		32		dBm
P _{-1dB}	Output power @ 1dB compression		20		dBm
Psat	Saturated Output Power		22.5		dBm
RLin	Input Return Loss		12		dB
RLout	Output Return Loss		20		dB
NF	Noise figure		4.5		dB
Id	Quiescent Drain current		180		mA
Vg	Gate voltage		-0.4		V

These values are representative of test fixture measurements that are made in the chips access plan.

A bonding wire of typically 0.1 to 0.15nH will improve the matching at the accesses.

“Power ON” sequence

1. Ground the device
2. Bias MPA gate voltage at Vg low enough (Typically: Vg $\approx$ -1V)
3. Apply Vds bias voltage (Typically: Vd = 4V)
4. Increase slowly Vgs up to quiescent bias drain current Idq
5. Apply RF signal

“Power OFF” sequence

1. Turn off RF signal
2. Bias MPA gate voltage at Vg low enough (Typically: Vg $\approx$ -1V)
3. Turn Vds bias voltage to 0V
4. Turn Vgs bias voltage to 0V

Absolute Maximum Ratings ⁽¹⁾T_{amb.} = +25°C

Symbol	Parameter	Values	Unit
V _d	Drain bias voltage	4.5V	V
I _d	Drain bias quiescent current	260	mA
V _g	Gate bias voltage	-2 to +0.4	V
V _{dg}	External drain-gate excursion	5	V
P _{in}	Maximum input power	6	dBm
T _j	Maximum junction temperature ⁽²⁾	175	°C

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

⁽²⁾ Thermal Resistance channel to ground paddle

Recommended Operating Range ^{3, 4}

Symbol	Parameter	Values	Unit
V _d	Drain bias voltage	3.3 to 4	V
I _d	Drain bias current	100 to 180	mA
V _g	Gate bias voltage	-1 to 0	V
P _{in}	Maximum peak input power overdrive	5	dBm

⁽³⁾ Electrical performances are defined for specified test conditions

⁽⁴⁾ Electrical performances are not guaranteed over all recommended operating conditions

Temperature Range

T _a	Operating temperature range	-40 to +95	°C
T _{stg}	Storage temperature range	-55 to +150	°C

Typical Bias ConditionsT_{amb.} = +25°C

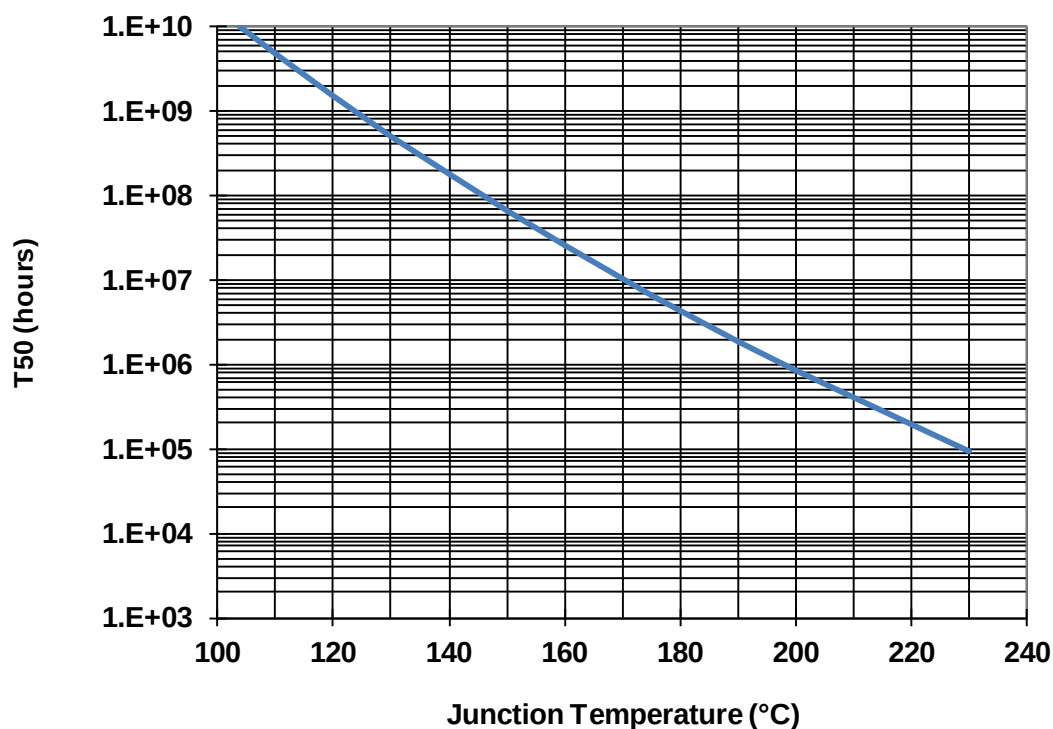
Symbol	Parameter	Values	Unit
VG1	DC Gate voltage 1 st stage	-0.4	V
VG2	DC Gate voltage 2 nd stage	-0.4	V
VG3	DC Gate voltage 3 rd stage	-0.4	V
VD1	DC Drain voltage 1 st stage	4.0	V
VD2	DC Drain voltage 2 nd stage	4.0	V
VD3	DC Drain voltage 3 rd stage	4.0	V

Device thermal information

The device thermal performances below are based on UMS rules to evaluate the junction temperature.

The temperature $T_{b_{chip}}$ is defined as the chip back side. The thermal resistance (R_{th_eq}) is given for the full circuit, and assumes CW operation mode in the table.

Thermal Resistance ⁽¹⁾	R_{th_eq}	$T_{b_{chip}} = 85^{\circ}\text{C}$, $V_d = 4\text{V}$, $I_{dq} = 180\text{mA}$	94.4	$^{\circ}\text{C/W}$
Junction Temperature	T_j	$P_{diss} = 720\text{mW}$	160	$^{\circ}\text{C}$



Typical test fixture Sij parameters

Tamb.= +25°C, Vd = +4V, Id = 180mA

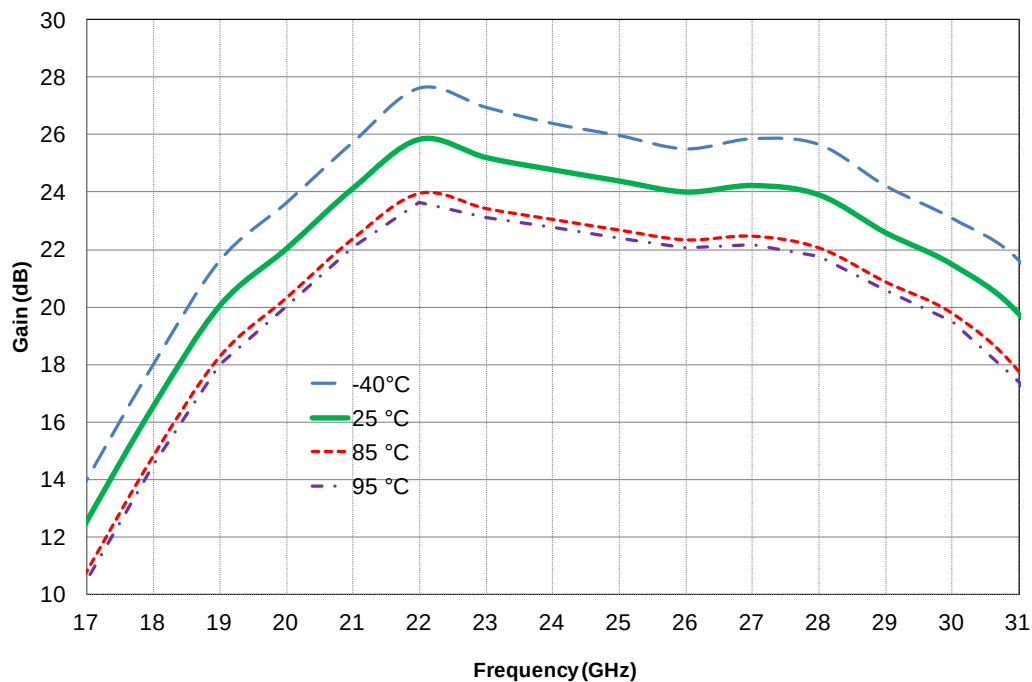
Freq (GHz)	S11 (dB)	PhS11 (°)	S12 (dB)	PhS12 (°)	S21 (dB)	PhS21 (°)	S22 (dB)	PhS22 (°)
2.0	-0.536	63.5	-63.708	-33.2	-64.063	-32.7	-1.074	38.1
3.0	-0.496	6.2	-62.062	-95.3	-62.702	-86.2	-1.033	-30.8
4.0	-0.483	-51.1	-63.501	-168.2	-63.540	-139.8	-1.112	-99.7
5.0	-0.561	-109.3	-70.089	138.5	-55.832	-173.8	-1.361	-169.3
6.0	-0.767	-167.5	-85.253	-158.3	-44.743	79.0	-1.667	120.3
7.0	-1.121	134.9	-67.613	-179.3	-35.106	-37.2	-1.977	49.7
8.0	-1.460	75.7	-63.555	119.1	-27.214	-146.4	-2.276	-20.5
9.0	-1.568	15.4	-62.670	50.8	-21.064	111.5	-2.667	-89.7
10.0	-1.469	-40.6	-62.911	-32.0	-15.864	16.7	-3.357	-158.8
11.0	-1.419	-93.0	-62.089	-151.1	-10.842	-74.3	-4.654	130.3
12.0	-1.508	-148.0	-57.192	98.2	-5.994	-166.0	-6.875	55.3
13.0	-1.615	152.1	-54.717	18.8	-1.919	100.9	-9.987	-27.2
14.0	-1.642	93.8	-53.780	-43.0	1.356	11.2	-12.973	-119.0
15.0	-1.808	39.7	-53.312	-79.4	4.624	-73.5	-14.372	151.0
16.0	-2.399	-17.1	-50.245	-125.4	8.426	-157.7	-15.274	76.4
17.0	-3.591	-84.3	-47.893	178.1	12.565	114.0	-18.240	17.9
18.0	-5.011	-163.3	-45.270	111.7	16.562	20.9	-24.111	-18.4
19.0	-6.054	108.9	-46.489	43.0	20.065	-78.2	-22.958	27.3
20.0	-7.698	27.1	-51.258	-31.8	22.043	-178.4	-14.162	-22.9
21.0	-10.667	-26.5	-59.478	-29.6	24.150	82.1	-15.368	-71.8
22.0	-15.857	-53.8	-63.627	-91.2	25.848	-21.6	-23.513	-123.8
23.0	-15.369	-86.1	-53.877	0.0	25.209	-124.6	-18.889	-85.3
24.0	-14.137	-127.7	-47.362	-70.6	24.783	141.4	-15.789	-107.8
25.0	-10.419	-161.5	-44.950	-129.6	24.392	48.7	-13.171	-144.3
26.0	-8.155	159.9	-43.528	170.8	24.011	-41.4	-13.052	162.1
27.0	-9.443	115.8	-42.957	111.3	24.236	-133.5	-18.511	101.9
28.0	-14.299	58.1	-43.822	52.5	23.907	128.4	-37.993	112.7
29.0	-17.581	-30.3	-45.992	-8.2	22.590	31.8	-30.117	-170.2
30.0	-12.263	-107.2	-52.894	-60.3	21.480	-63.9	-18.299	-149.9
31.0	-6.762	178.2	-54.003	-21.0	19.755	-165.5	-11.250	158.0
32.0	-3.035	106.3	-49.823	-77.4	16.274	92.4	-7.671	92.8
33.0	-1.798	47.5	-50.759	-113.1	11.758	1.2	-6.671	17.7
34.0	-1.675	-8.3	-51.892	-155.5	7.936	-84.3	-6.471	-66.5
35.0	-1.732	-77.5	-51.394	-83.5	4.001	-173.2	-5.856	-154.4
36.0	-1.414	-148.1	-36.881	-169.8	-1.254	99.8	-5.514	118.7
37.0	-1.195	158.7	-34.715	103.1	-6.734	21.0	-5.095	30.3
38.0	-1.142	114.6	-34.098	12.8	-11.972	-55.2	-4.453	-66.9
39.0	-1.136	68.1	-39.290	-54.0	-18.737	-134.3	-3.041	-164.1
40.0	-1.249	17.4	-44.969	-100.3	-27.448	154.8	-2.185	114.4

Typical test fixture Measurements

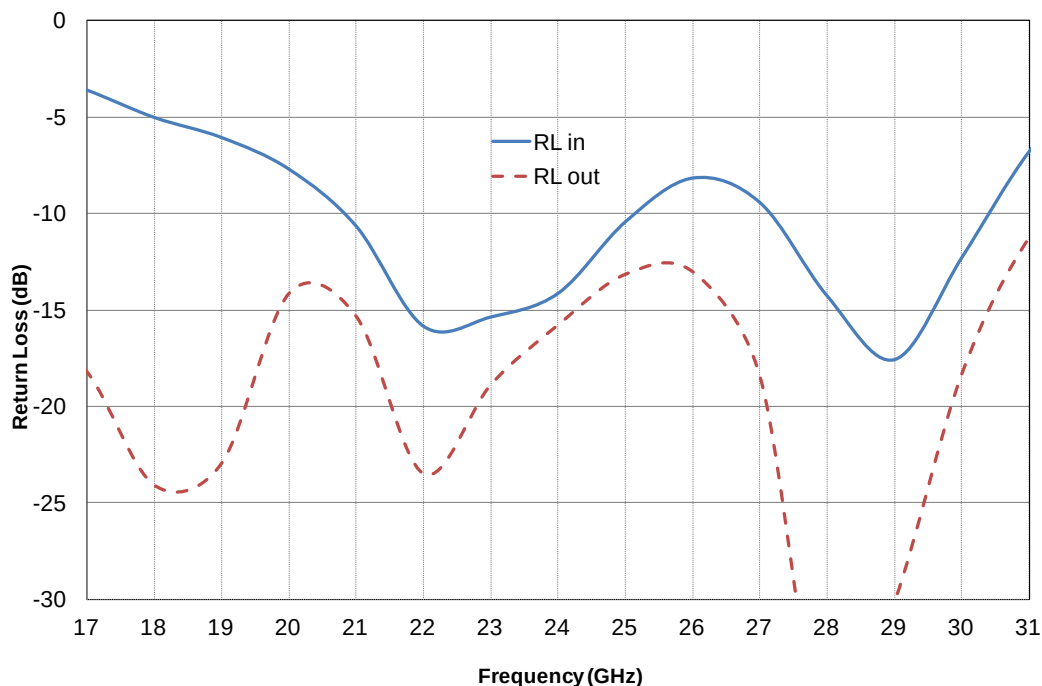
Tamb.= +25°C, Vd = +4.0V, Id = 180mA

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

Linear Gain versus Frequency in Temperature



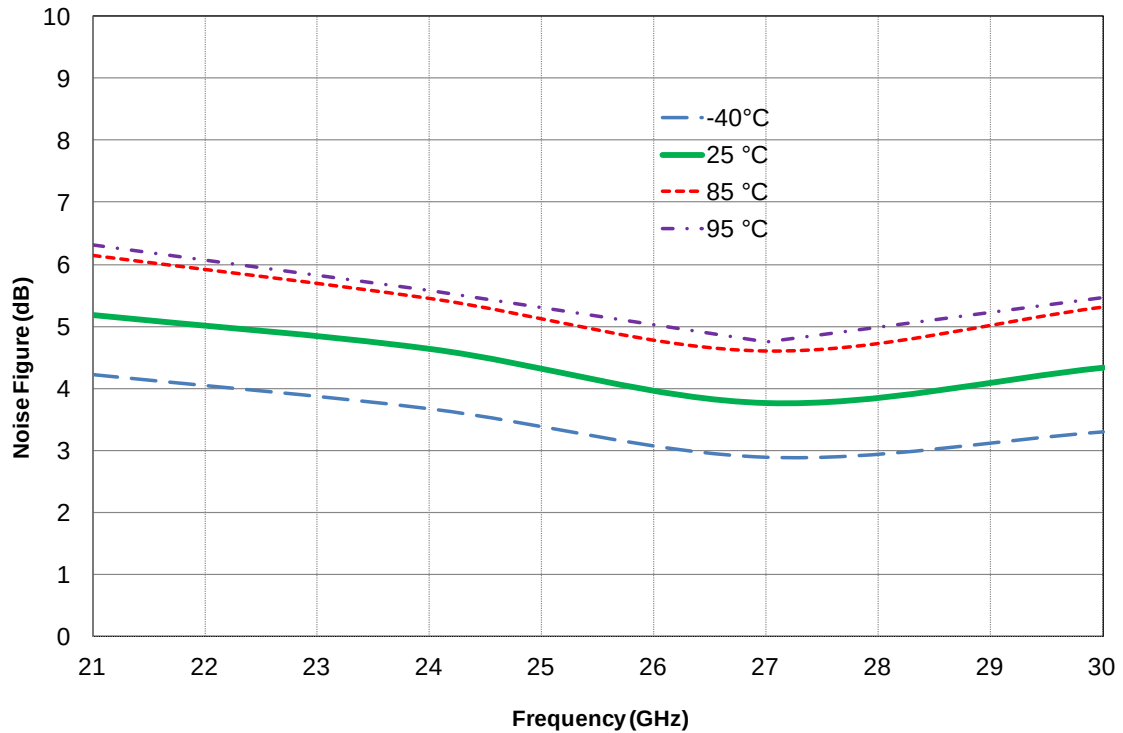
Return losses versus Frequency



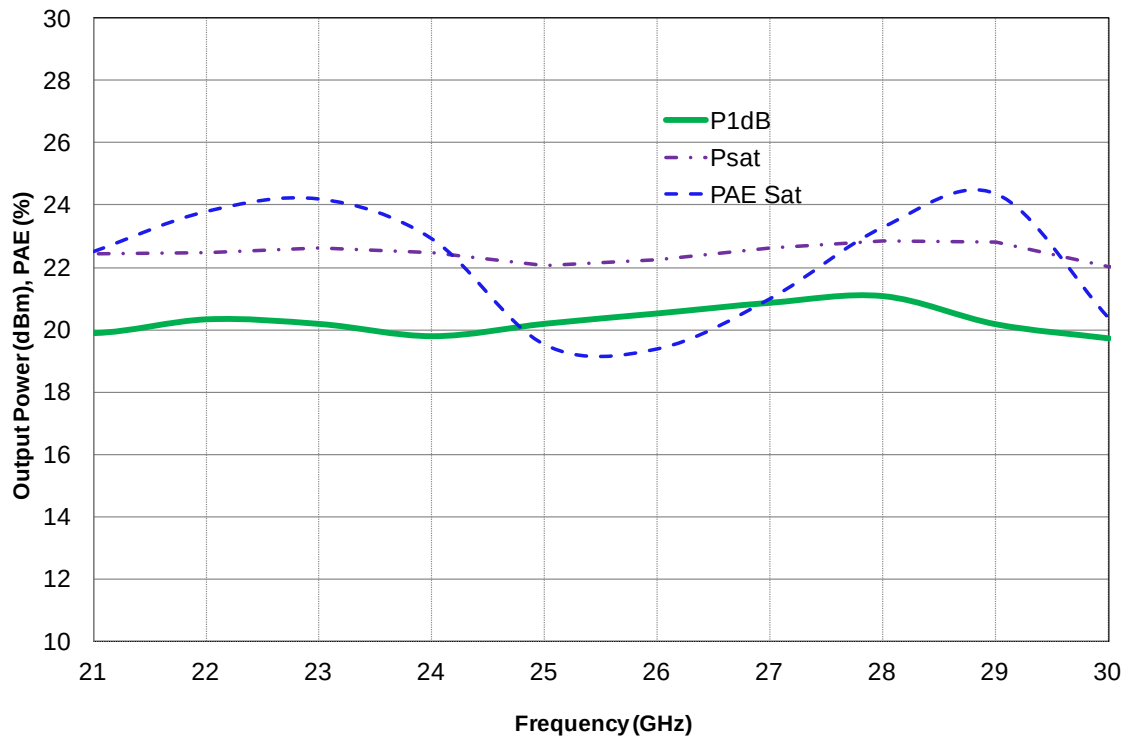
Typical test fixture Measurements

Tamb.= +25°C, Vd = +4.0V, Id = 180mA

Noise Figure versus Temperature



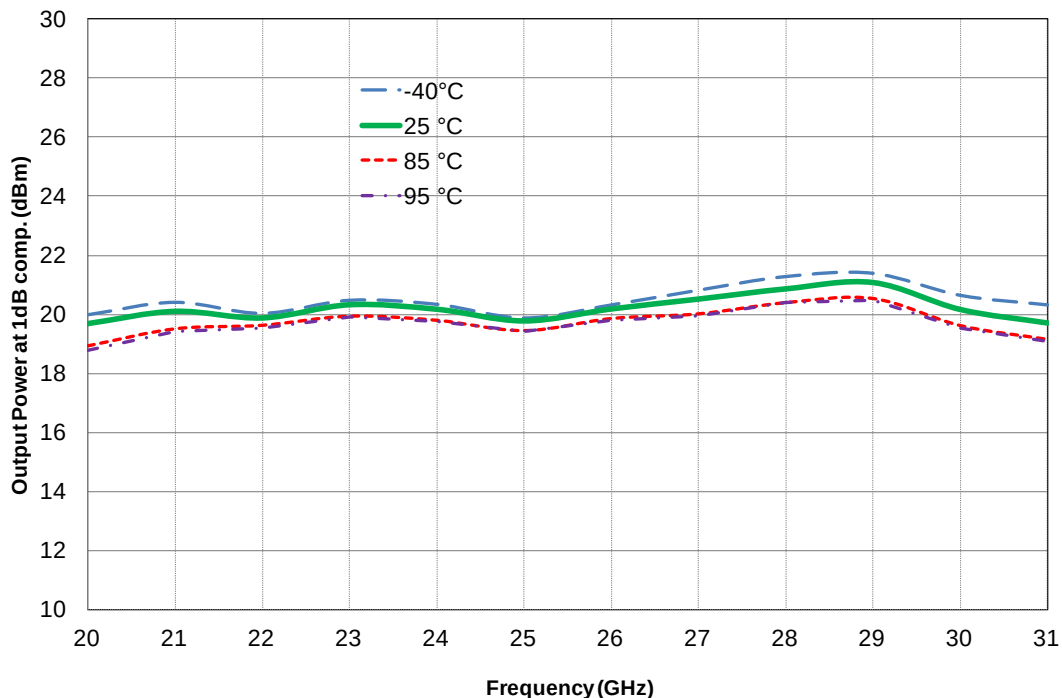
Output Power & PAE versus Frequency



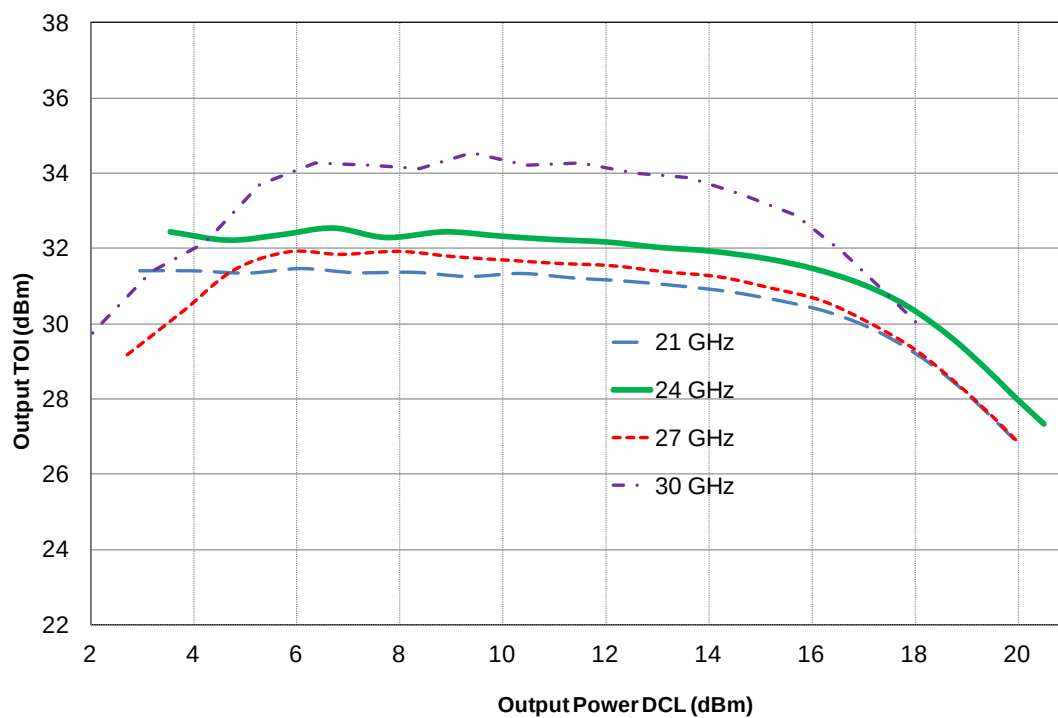
Typical Board Measurements

Tamb.= +25°C, Vd = +4.0V, Id = 180mA

Pout at 1dB compression versus Temperature

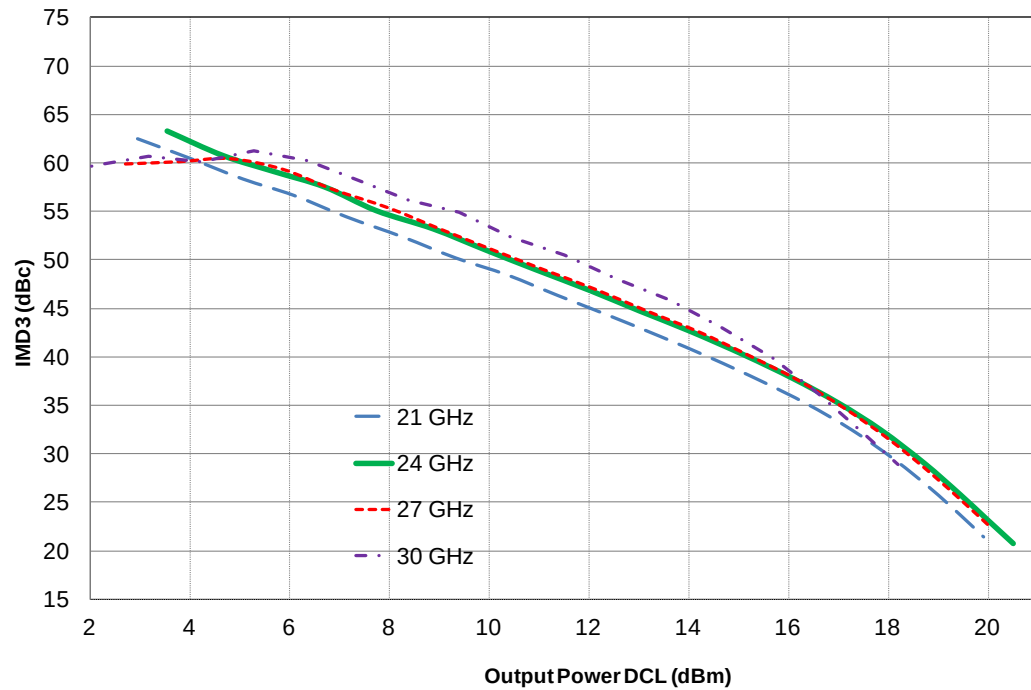
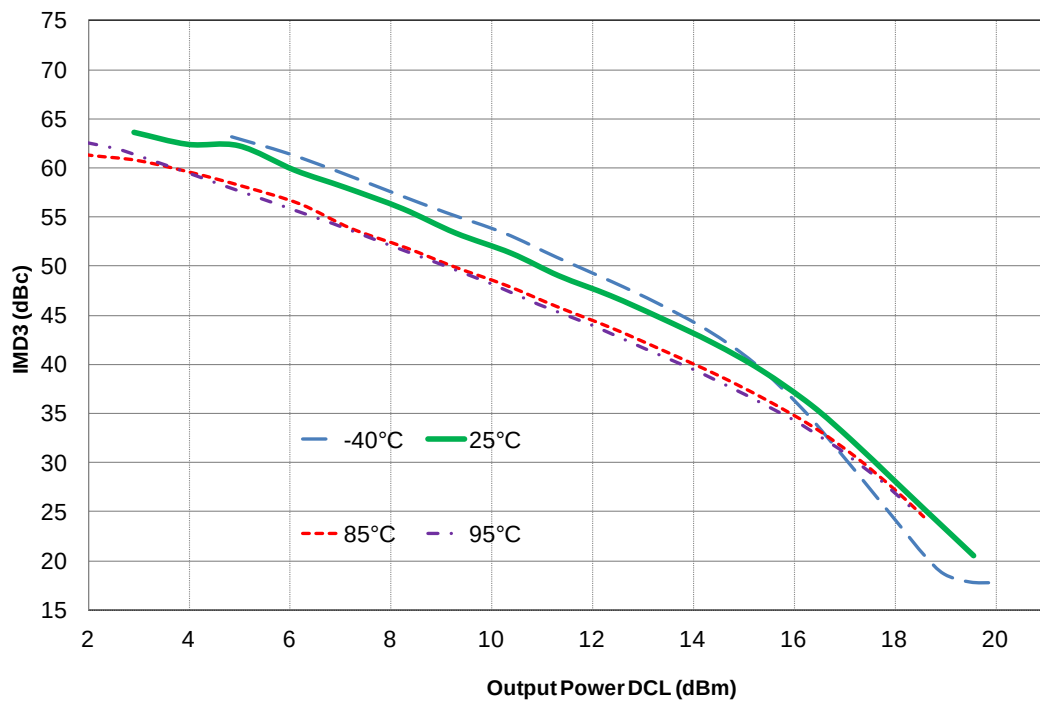


Output TOI versus Output Power DCL

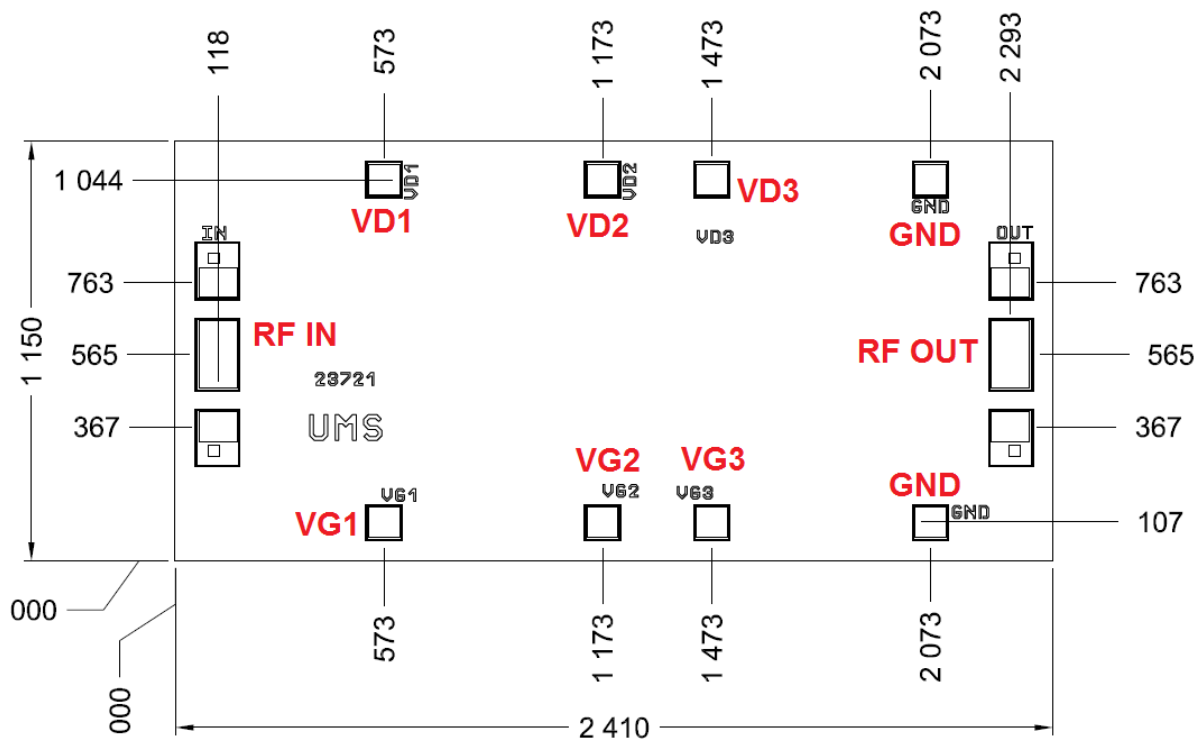


Typical Board Measurements

Tamb.= +25°C, Vd = +4.0V, Id = 180mA

IMD3 versus Output Power DCL**IMD3 versus Temperature at 26GHz**

Mechanical data



Chip thickness: 100μm.

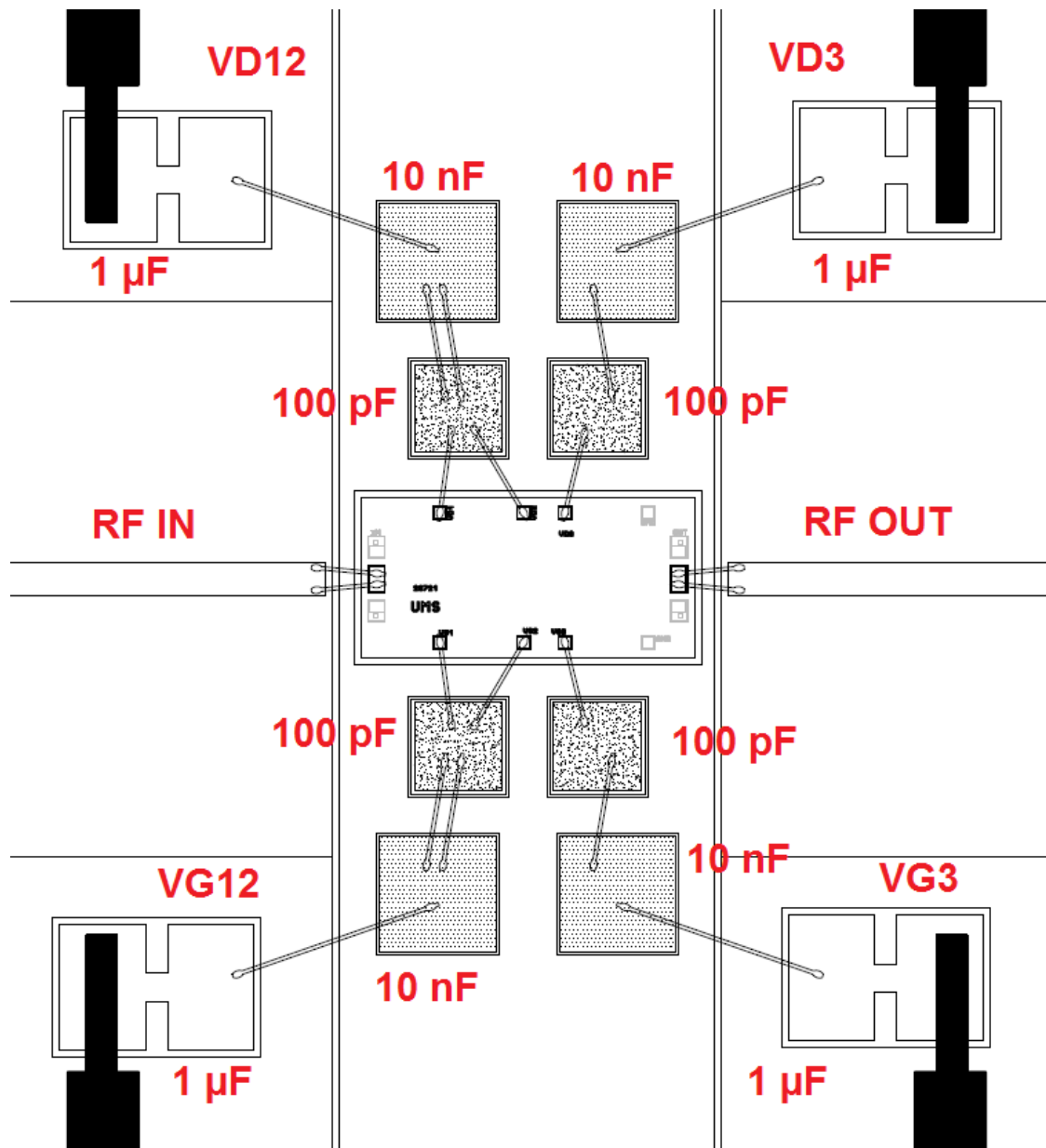
Chip size: 2410x1150 ±35μm

DC pad size: 83μm x 86 μm (BCB opening)

RF pad size: 97μm x 146 μm (BCB opening)

All dimensions are in micrometers

Recommended assembly plan



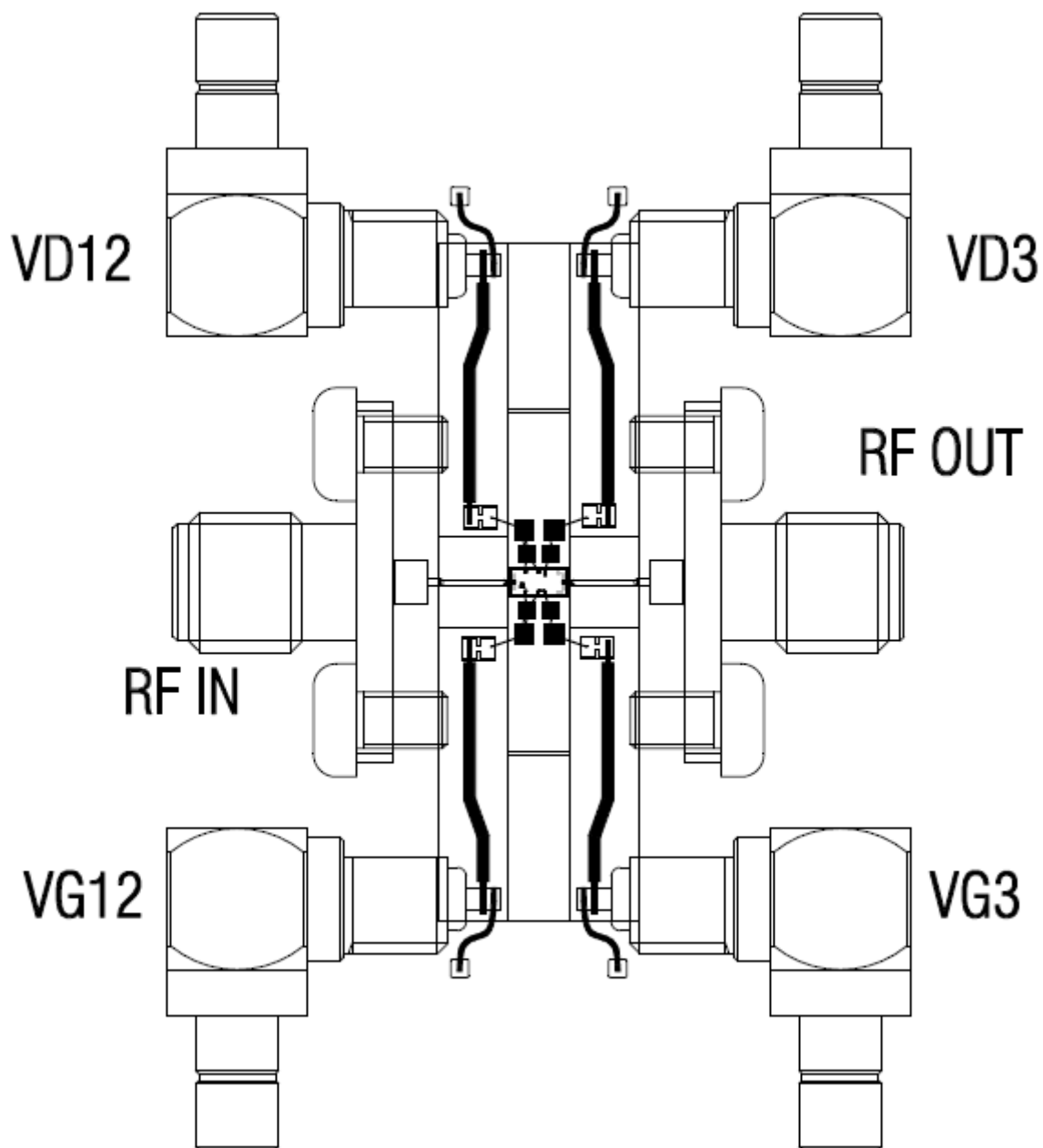
Note: Supply feed should be bypassed. 25µm diameter gold wire is to be preferred.

Recommended circuit bonding table

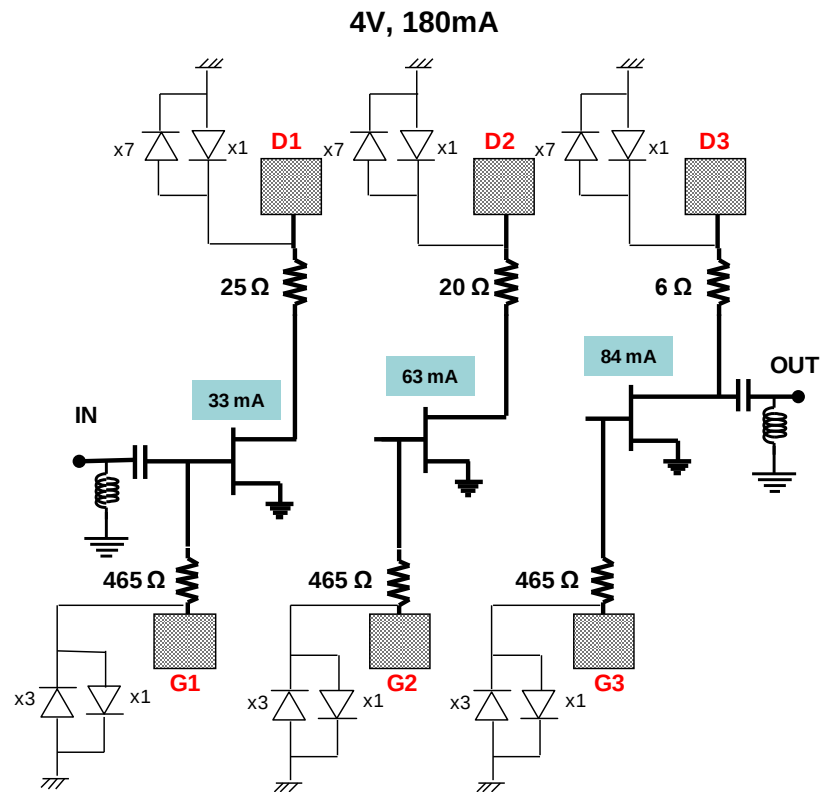
Label	Type	Decoupling	Comment
VD12, VD3	Vd	100pF & 10nF & 1µF	Drain Supply
VG12, VG3,	Vg	100pF & 10nF & 1µF	Gate Supply

Evaluation mother board

- Decoupling capacitors of 100nF $\pm 10\%$, 10nF $\pm 20\%$ and 1 μ F $\pm 10\%$ are recommended for all DC accesses.
- Note: All board measurements are performed using shielded cables, even for DC bias, to ensure safe operation.



DC Schematic



Notes

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 products.

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>.

User guide for bare dies

Refer to the application note AN0001 available at <https://www.ums-rf.com> for UMS user guide for bare dies handling

Ordering Information

Chip form:

CHA3395-98F/00

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