

36-43.5GHz Medium Power Amplifier

GaAs Monolithic Microwave IC in SMD leadless package

Description

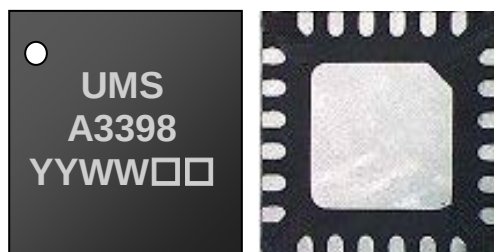
The CHA3398-QDG is a 4 stages monolithic Medium Power Amplifier, producing 21dB gain for 18dBm output power.

It is specially designed for Point To Point Telecom Radio.

The CHA3398-QDG is recommended as a driver for the CHA5659-QXG power amplifier.

The circuit is manufactured with a pHEMT process, 0.15μm gate length, via holes through the substrate, air bridges and electron beam gate lithography.

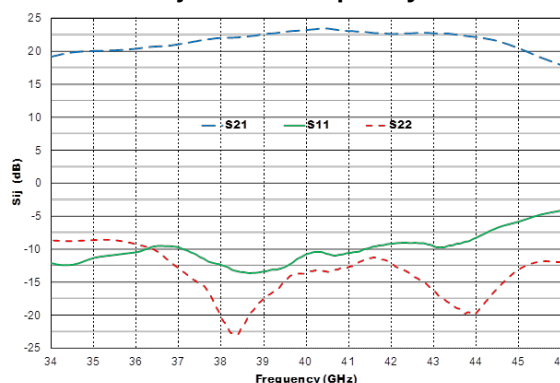
It is supplied in RoHS compliant SMD package.



Main Features

- Broadband performances: 36-43.5GHz
- 18dBm Pout at 1dB compression
- 22dB gain
- 29dBm OTOI
- DC bias: Vd=4.0Volt@Id=200mA
- 24L-QFN4x4
- MSL1

Sij versus Frequency



Main Electrical Characteristics

Tamb.= +25°C

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	36.0		43.5	GHz
Gain	Linear Gain		22		dB
P-1dB	Output Power @1dB comp.		18		dBm
OTOI	3 rd order Intercept point		29		dBm

Specifications

Tamb.= +25°C, Vd = +4.0V

Symbol	Parameter	Min	Typ	Max	Unit
Freq	Frequency range	36.0		43.5	GHz
Gain	Linear Gain		22		dB
ΔG	Gain variation in temperature		0.034		dB/°C
G _{CTRL}	Gain control range		15		dB
OTOI	3 rd order Intercept point		29		dBm
P _{-1dB}	Output power @ 1dB in 36-40GHz		17		dBm
	Output power @ 1dB in 40.5-43.5GHz		18		
Psat	Saturated Output Power		19		dBm
RLin	Input Return Loss		10		dB
RLout	Output Return Loss		10		dB
NF	Noise figure		6.5		dB
Id	Quiescent Drain current		200		mA
Vg	Gate voltage		-0.35		V

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

“Power ON” sequence

1. Ground the device
2. Bias MPA gate voltage at Vg low enough (Typically: Vg ≈ -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 ≈ -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	330	mA
V _g	Gate bias voltage	-2 to 0	V
V _{dg}	External drain-gate excursion	5	V
P _{in}	Maximum input power ⁽²⁾	5	dBm
T _j	Maximum junction temperature ⁽³⁾	175	°C

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

⁽²⁾ Duration < 1s.

⁽³⁾ Thermal Resistance channel to ground paddle

Recommended Operating Range ^{4, 5}

Symbol	Parameter	Values	Unit
V _d	Drain bias voltage	3.3 to 4	V
I _d	Drain bias current	100 to 200	mA
V _g	Gate bias voltage	-2 to 0	V
P _{in}	Maximum peak input power overdrive	5	dBm

⁽⁴⁾ Electrical performances are defined for specified test conditions

⁽⁵⁾ 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	Pad N°	Parameter	Values	Unit
VG1	8	DC Gate voltage 1 st stage	-0.35	V
VG2	9	DC Gate voltage 2 nd stage	-0.35	V
VG3	10	DC Gate voltage 3 rd stage	-0.35	V
VG4	11	DC Gate voltage 4 th stage	-0.35	V
VD1	23	DC Drain voltage 1 st stage	4.0	V
VD2	22	DC Drain voltage 2 nd stage	4.0	V
VD3	20	DC Drain voltage 3 rd stage	4.0	V
VD4	19	DC Gate voltage 4 th stage	4.0	V

Device thermal performances

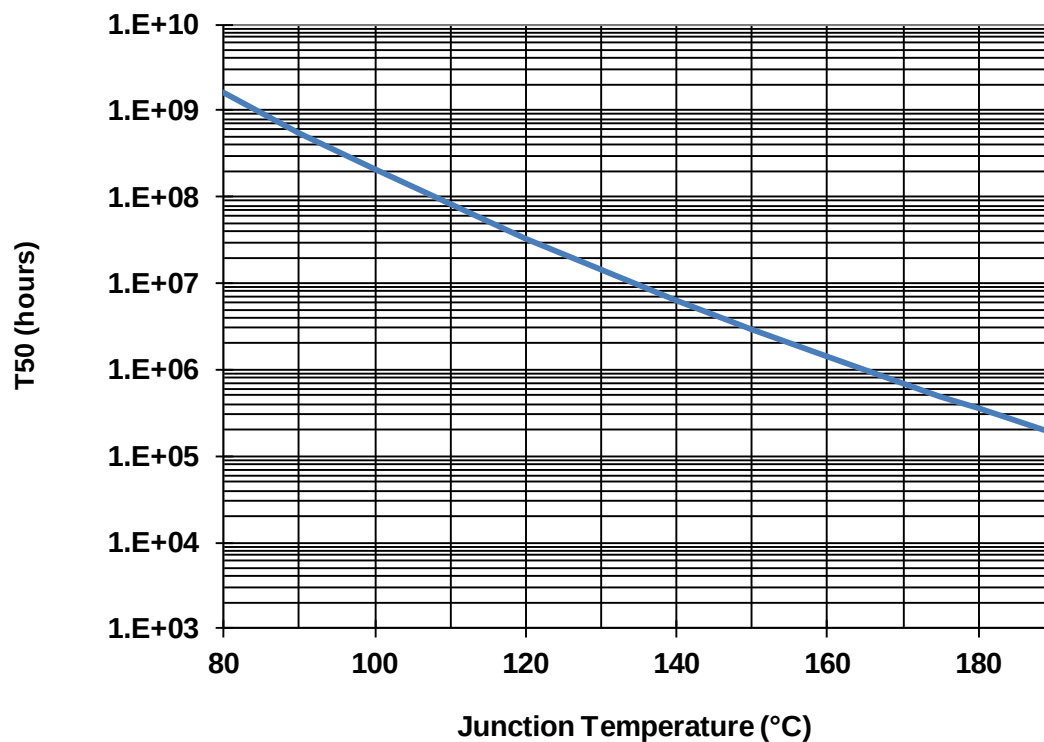
All the figures given in this section are obtained assuming that the QFN device is only cooled down by conduction through the package thermal pad (no convection mode considered).

The temperature is monitored at the package back-side interface (Tcase).

The system maximum temperature must be adjusted in order to guarantee that Tjunction remains below the maximum value specified in the Absolute Maximum Ratings table.

So, the system PCB must be designed to comply with this requirement.

Parameter	Biasing conditions	Tjunction (°C)	R _{TH} (°C/W)	T50 (hours)
R _{TH} ⁽¹⁾ Thermal Resistance (Junction to Case)	Vd= 4V Id= 200mA Pdiss= 0.8W	165	96.5	1.0E+6
⁽¹⁾ Assuming 85°C Tcase				



Typical Package Sij parameters

Tamb.= +25°C, Vd = +4.0V, Id = 200mA

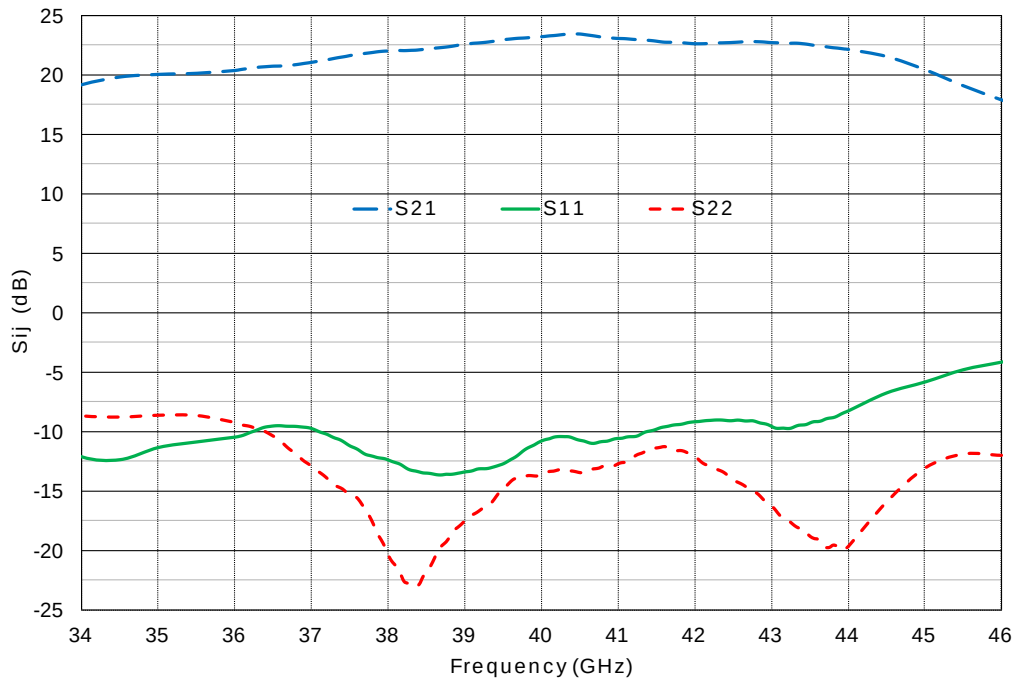
Freq (GHz)	S11 (dB)	PhS11 (°)	S21 (dB)	PhS21 (°)	S12 (dB)	PhS12 (°)	S22 (dB)	PhS22 (°)
10	-0.3	0.1	-34.9	82.3	-56.8	-46.8	-11.3	56.4
11	-0.4	-14.4	-31.2	40.5	-57.1	-87.9	-8.0	29.0
12	-0.4	-27.7	-28.1	2.2	-58.0	-143.2	-6.6	8.9
13	-0.4	-40.3	-24.9	-39.5	-72.3	-179.5	-6.3	-4.7
14	-0.5	-53.0	-24.1	-86.8	-57.1	-149.2	-6.0	-13.7
15	-0.6	-66.4	-25.0	-120.2	-54.4	130.6	-6.1	-23.1
16	-0.7	-81.3	-25.8	-124.6	-58.2	116.7	-6.5	-33.5
17	-0.8	-98.8	-21.8	-123.0	-49.7	104.8	-7.4	-45.4
18	-0.9	-120.2	-15.1	-136.1	-46.7	60.5	-9.1	-59.6
19	-1.0	-146.3	-7.9	-168.1	-47.7	32.5	-11.6	-78.1
20	-1.2	-176.4	-1.0	144.2	-59.6	36.8	-14.8	-110.8
21	-1.9	155.3	3.8	82.5	-51.5	21.3	-16.0	-162.0
22	-2.4	135.3	5.9	21.0	-48.1	6.5	-13.3	156.9
23	-2.1	117.9	6.8	-32.1	-47.5	12.8	-10.6	135.6
24	-1.8	101.9	7.4	-79.5	-45.4	-1.0	-8.5	124.3
25	-1.7	88.5	8.1	-123.2	-47.0	-24.5	-7.0	116.2
26	-1.8	77.2	8.7	-166.7	-45.0	-29.5	-5.9	110.7
27	-2.0	67.5	9.1	153.2	-43.8	-41.7	-4.9	105.9
28	-2.2	58.6	9.7	115.1	-45.0	-53.1	-4.4	101.5
29	-2.6	49.2	10.4	78.7	-43.7	-69.6	-4.1	96.7
30	-3.2	38.6	11.6	42.0	-43.3	-66.5	-4.0	93.4
31	-4.0	26.5	13.2	9.7	-42.8	-78.5	-4.0	87.1
32	-5.3	5.3	15.7	-34.9	-40.5	-71.6	-5.1	78.1
33	-8.7	-26.6	16.7	-75.9	-37.4	-106.1	-7.4	78.6
34	-12.2	-88.8	19.2	-121.5	-37.7	-125.8	-8.7	85.8
35	-11.4	-171.9	20.1	-173.9	-37.8	-152.5	-8.6	90.7
36	-10.5	150.8	20.4	140.4	-38.6	-168.9	-9.2	79.2
37	-9.8	125.6	21.1	94.8	-39.2	163.5	-12.9	61.4
38	-12.4	119.7	22.0	45.9	-45.3	112.3	-20.4	3.7
39	-13.4	135.7	22.6	-2.4	-49.3	-155.6	-17.4	-137.8
40	-10.8	145.1	23.2	-54.5	-43.8	-165.5	-13.6	-161.6
41	-10.6	142.4	23.1	-109.9	-41.0	163.0	-12.7	-165.2
42	-9.2	137.1	22.7	-161.4	-44.2	137.2	-12.1	178.5
43	-9.6	125.8	22.7	144.2	-42.7	151.5	-16.2	-179.9
44	-8.3	127.6	22.2	85.1	-45.9	117.6	-19.6	-135.7
45	-5.8	106.7	20.5	22.0	-45.5	141.1	-13.0	-113.2
46	-4.1	72.3	17.9	-35.6	-42.6	138.8	-12.0	-120.8
47	-2.9	29.3	15.5	-96.0	-38.1	115.9	-11.3	-116.3
48	-3.1	-15.2	11.3	-158.5	-36.8	68.7	-11.3	-137.0
49	-4.3	-48.3	6.5	144.5	-36.2	8.9	-18.2	143.8
50	-5.8	-67.0	-0.3	80.1	-43.3	-79.6	-7.7	9.1

Typical Board Measurements

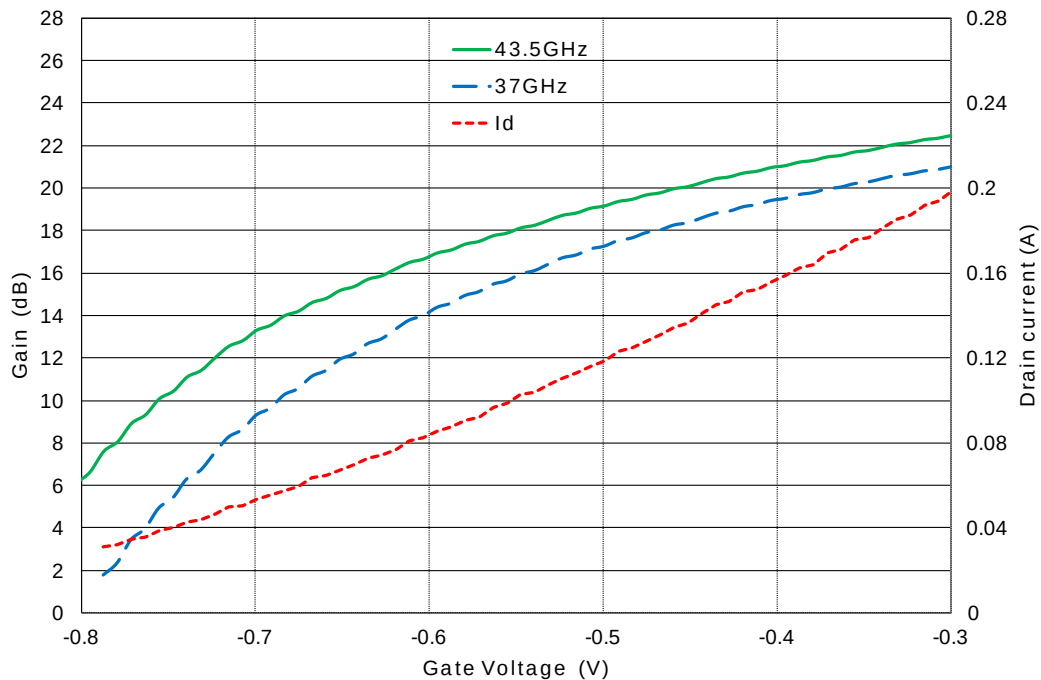
Tamb.= +25°C, Vd = +4.0V, Id = 200mA

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

S parameters versus Frequency (in QFN plan)



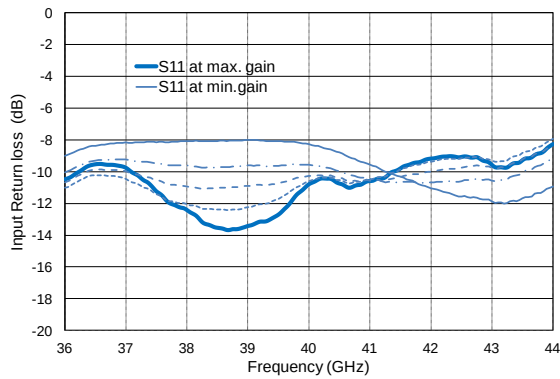
Linear gain & current versus gate voltage



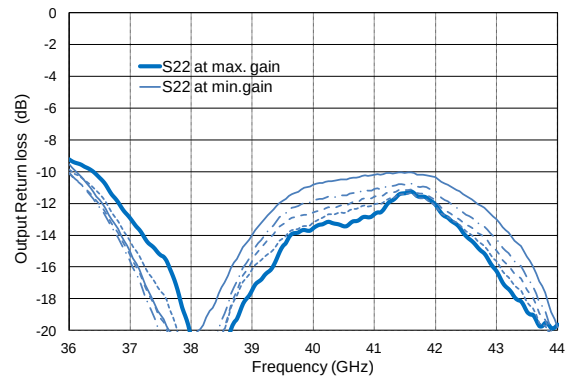
Typical Board Measurements

Tamb.= +25°C, Vd = +4.0V, Id = 200mA

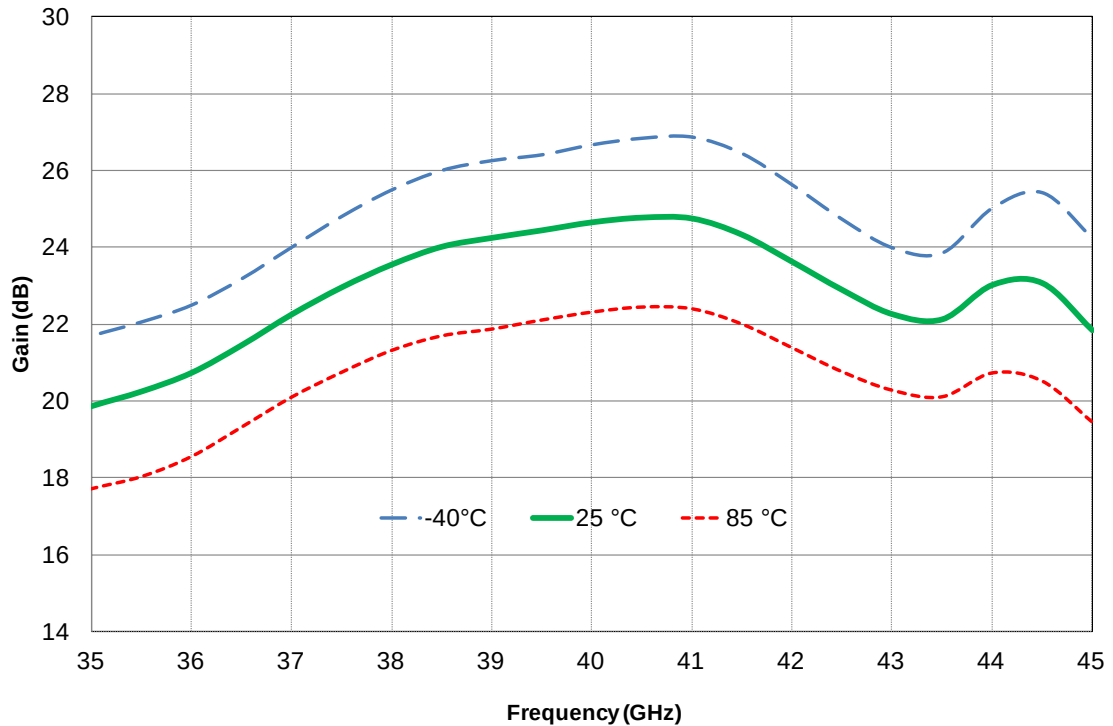
Input return loss versus Gain Control Voltage



Output return loss versus Gain Control Voltage

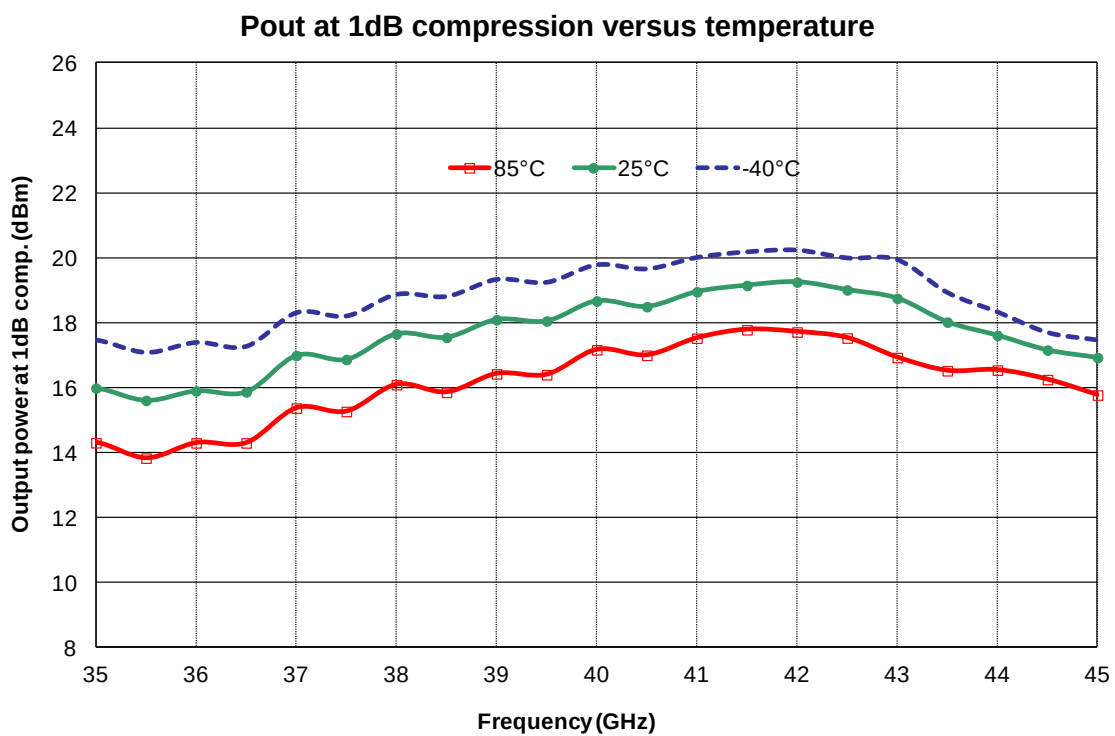
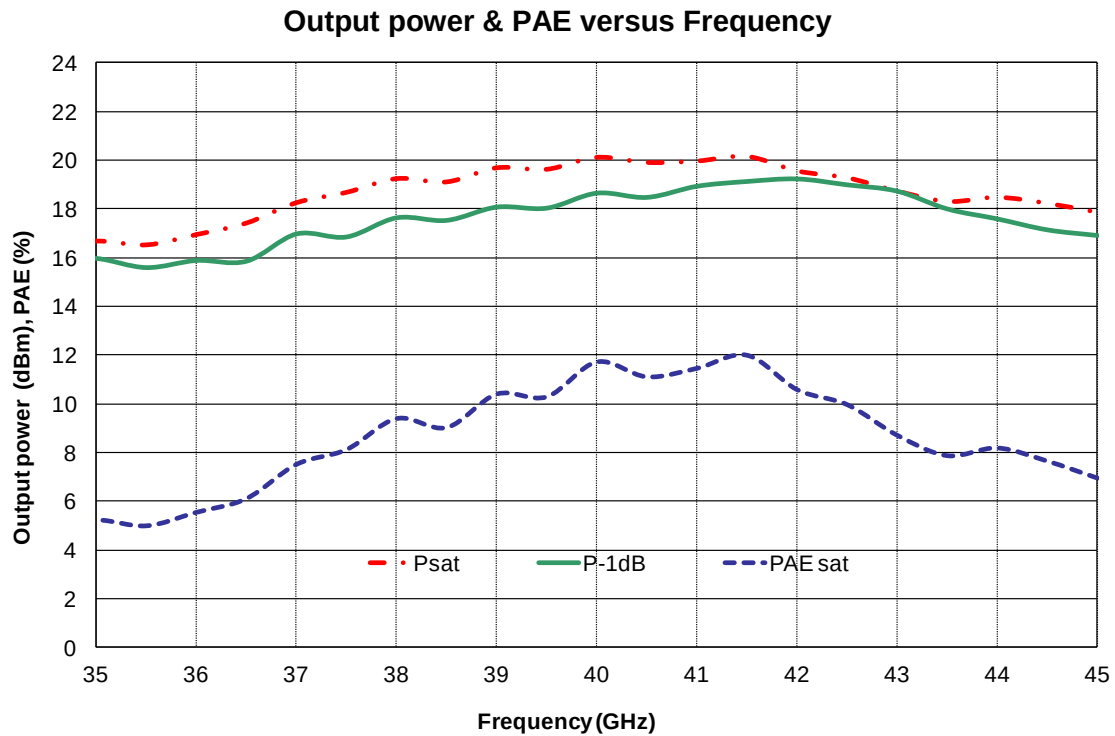


Linear Gain versus Frequency in Temperature



Typical Board Measurements

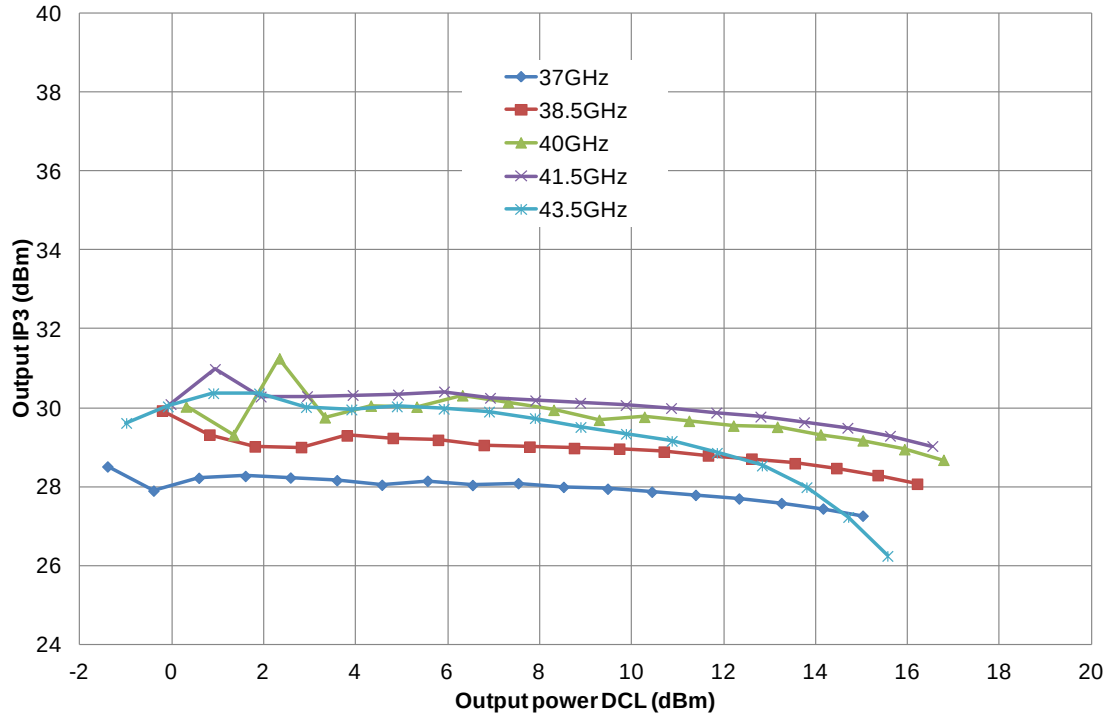
Tamb.= +25°C, Vd = +4.0V, Id = 200mA



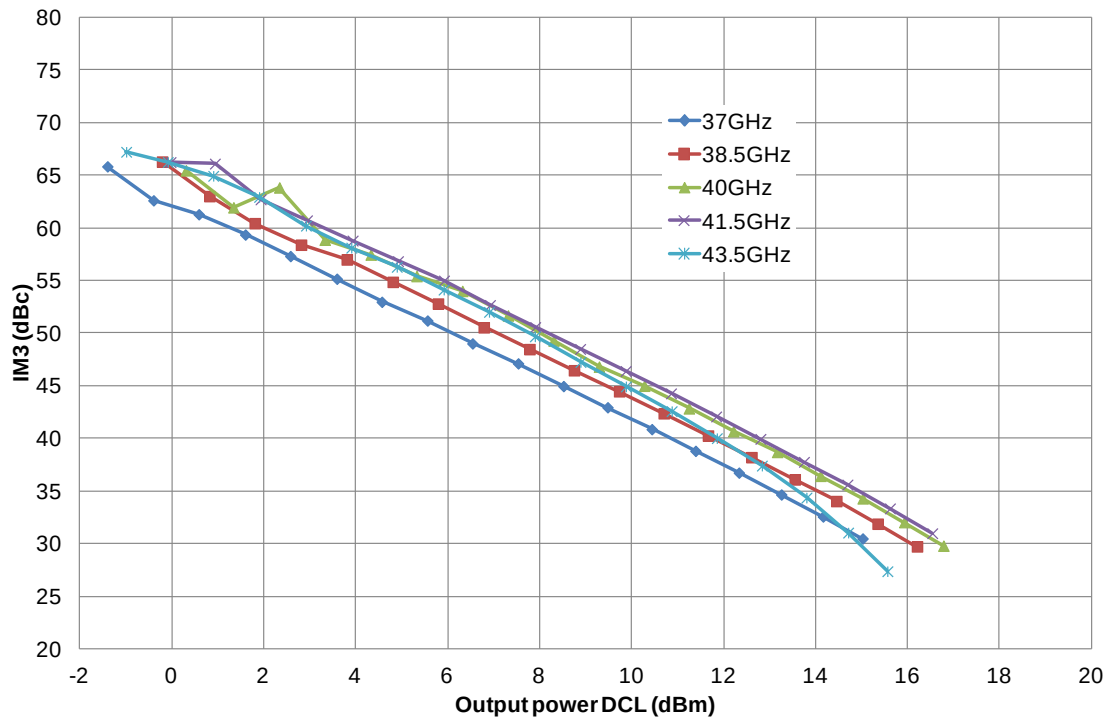
Typical Board Measurements

T_{amb.} = +25°C, V_d = +4.0V, I_d = 200mA

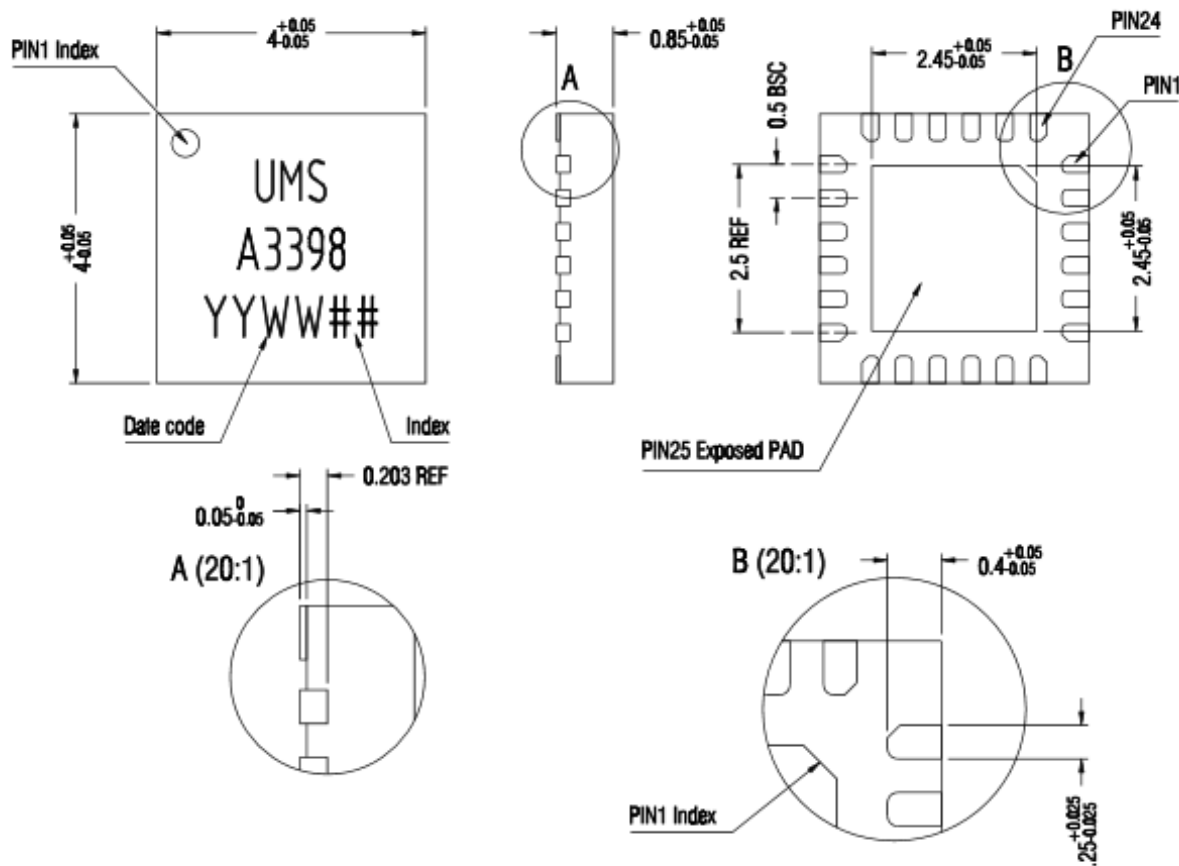
Output TOI versus Output Power DCL



IMD3 versus Output Power DCL



Package outline ⁽¹⁾



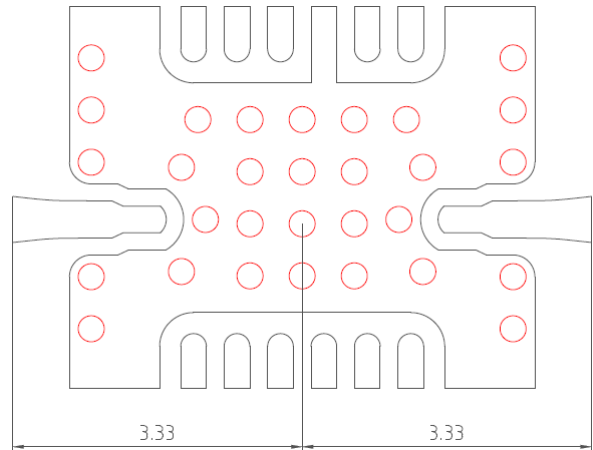
Matt tin, Lead Free	(Green)	1- NC	9- Vg2	17- Gnd ⁽²⁾
Units :	mm	2- Gnd ⁽²⁾	10- Vg3	18- NC
From the standard :	JEDEC MO-220	3- Gnd ⁽²⁾	11- Vg4	19- Vd4
	(VGGD)	4- RF IN	12- NC	20- Vd3
	25- GND	5- Gnd ⁽²⁾	13- Gnd ⁽²⁾	21- Gnd ⁽²⁾
		6- Gnd ⁽²⁾	14- Gnd ⁽²⁾	22- Vd2
		7- NC	15- RF OUT	23- Vd1
		8- Vg1	16- Gnd ⁽²⁾	24- NC

⁽¹⁾ The package outline drawing included to this data-sheet is given for indication. Refer to the application note AN0017 (<https://www.ums-rf.com>) for exact package dimensions.

⁽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.

Definition of the Sij reference planes

The reference planes used for Sij measurements given above are symmetrical from the symmetrical axis of the package (see drawing beside). The input and output reference planes are located at 3.33mm offset (input wise and output wise respectively) from this axis. Then, the given Sij parameters incorporate the land pattern of the evaluation motherboard recommended in paragraph "Evaluation motherboard".



ESD sensitivity

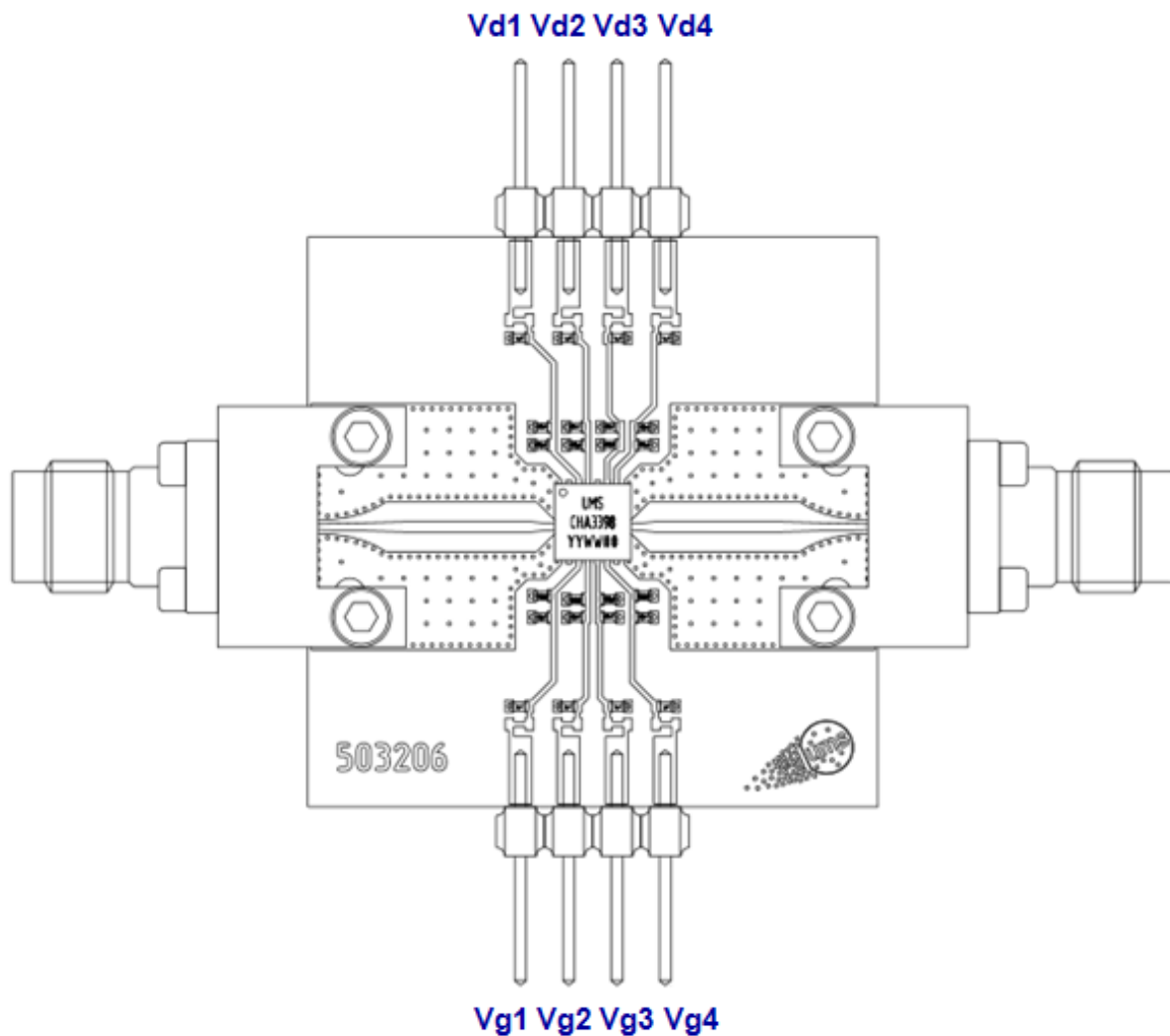
Standard	Value
MIL-STD-1686C	HBM Class 1
ESD STM5.1-1998	HBM Class 1A

Package Information

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

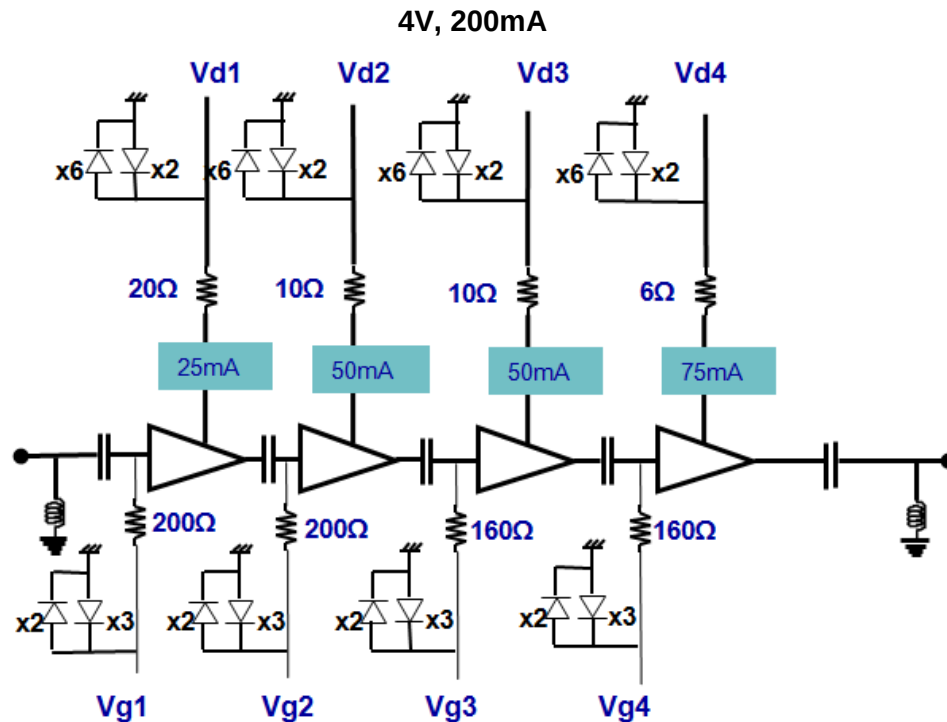
Evaluation mother board

- Compatible with the proposed footprint.
- Based on typically Ro4350B / 10mils 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 100pF $\pm 5\%$, 10nF $\pm 10\%$ and 1 μ F $\pm 10\%$ 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.

DC Schematic



Notes

Due to ESD protection circuits on RF input and output, an external capacitance might be requested to isolate the product from external voltage that could be present on the RF accesses.

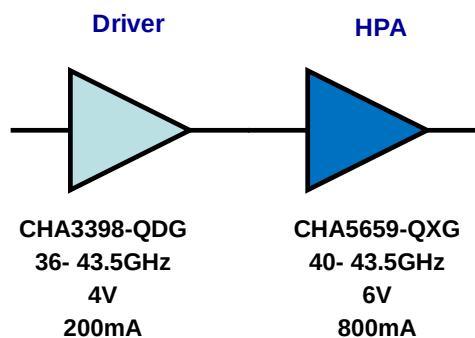
The DC connections do not include any decoupling capacitor in package, therefore it is mandatory to provide a good external DC decoupling (100pF, 10nF, 1μF) on the PC board, as close as possible to the package.

Recommended UMS Power chain

The CHA5659-QXG is recommended with the CHA3398-QDG as driver.

Total Gain: 42dB

Gain control: 30dB with the both amplifiers.



Recommended package footprint

Refer to the application note AN0017 available at <https://www.ums-rf.com> for package footprint 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.

Ordering Information

QFN 4x4 package:

CHA3398-QDG/XY

Stick: XY = 20

Tape & reel: XY = 21

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