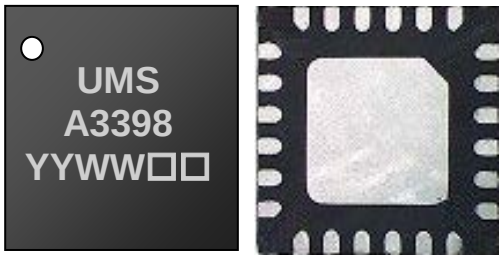
36-43.5GHz Medium Power Amplifier

GaAs Monolithic Microwave IC in SMD leadless package

Description

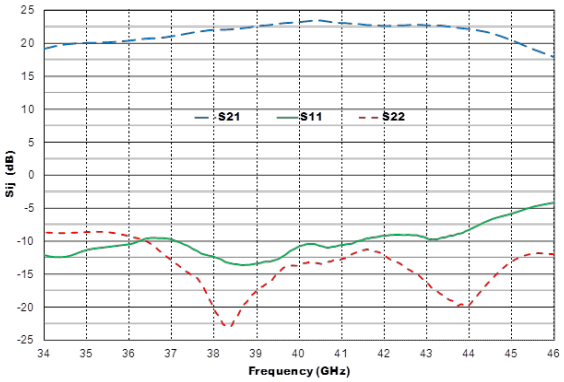
The CHA3398-QDG is a 4 stages monolithic Medium Power Amplifier, producing 21dB gain for 18dBm output power.
It is specially designed for Point To Point Telecom Radio.
The CHA3398-QDG is recommended as a driver for the CHA5659-QXG power amplifier.
The circuit is manufactured with a pHEMT process, 0.15µm 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	3rd order Intercept point		29		dBm

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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	3rd order Intercept point		29		dBm
P_{-1dB}	Output power @ 1dB in 36-40GHz Output power @ 1dB in 40.5-43.5GHz		17 18		dBm
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

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Absolute Maximum Ratings (1)

Tamb.= +25°C

Symbol	Parameter	Values	Unit
Vd	Drain bias voltage	4.5V	V
Id	Drain bias quiescent current	330	mA
Vg	Gate bias voltage	-2 to 0	V
Vdg	External drain-gate excursion	5	V
Pin	Maximum input power (2)	5	dBm
Tj	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
Vd	Drain bias voltage	3.3 to 4	V
Id	Drain bias current	100 to 200	mA
Vg	Gate bias voltage	-2 to 0	V
Pin	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

Ta	Operating temperature range	-40 to +95	°C
Tstg	Storage temperature range	-55 to +150	°C

Typical Bias Conditions

Tamb.= +25°C

Symbol	Pad Nº	Parameter	Values	Unit
VG1	8	DC Gate voltage 1st stage	-0.35	V
VG2	9	DC Gate voltage 2nd stage	-0.35	V
VG3	10	DC Gate voltage 3rd stage	-0.35	V
VG4	11	DC Gate voltage 4th stage	-0.35	V
VD1	23	DC Drain voltage 1st stage	4.0	V
VD2	22	DC Drain voltage 2nd stage	4.0	V
VD3	20	DC Drain voltage 3rd stage	4.0	V
VD4	19	DC Gate voltage 4th stage	4.0	V

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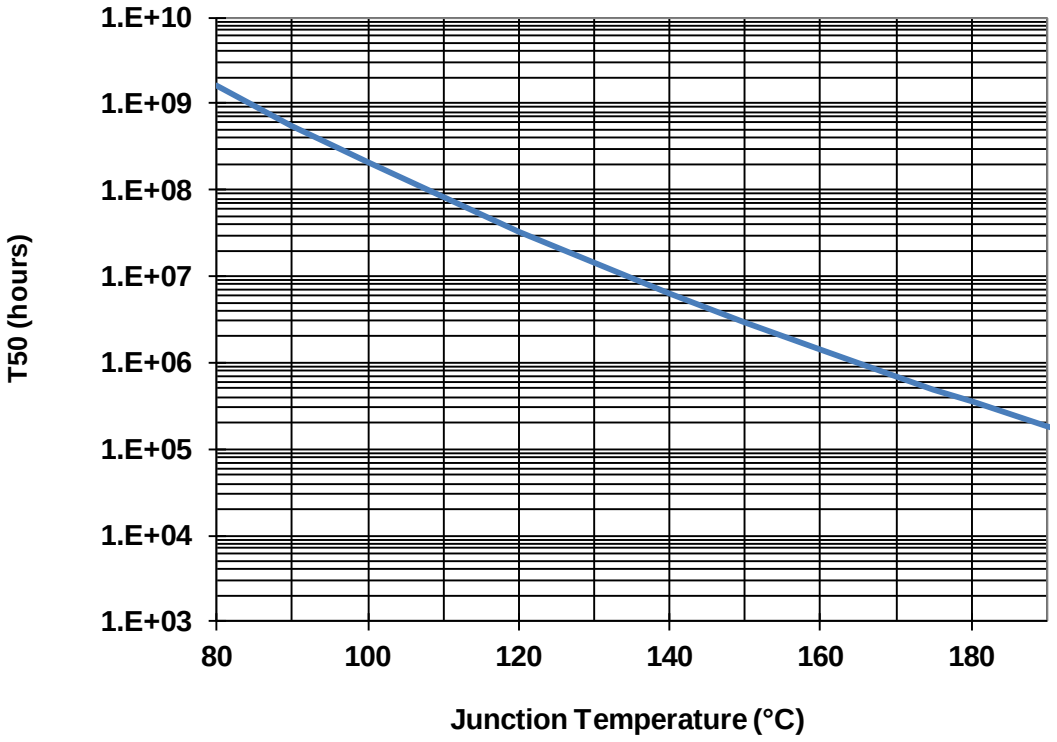
Device thermal performances

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				



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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

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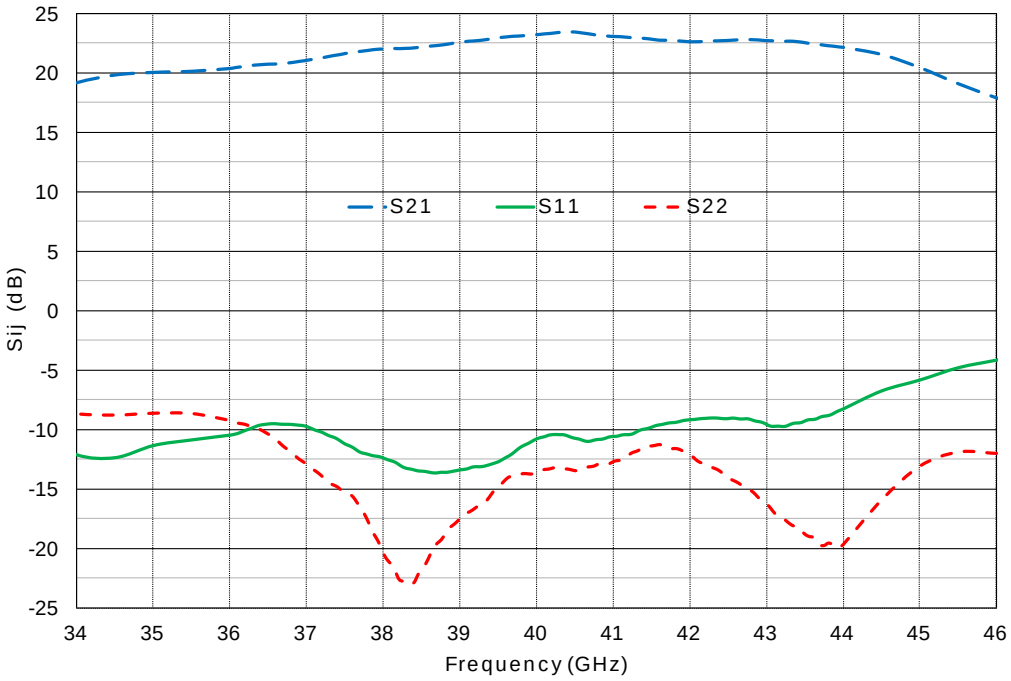
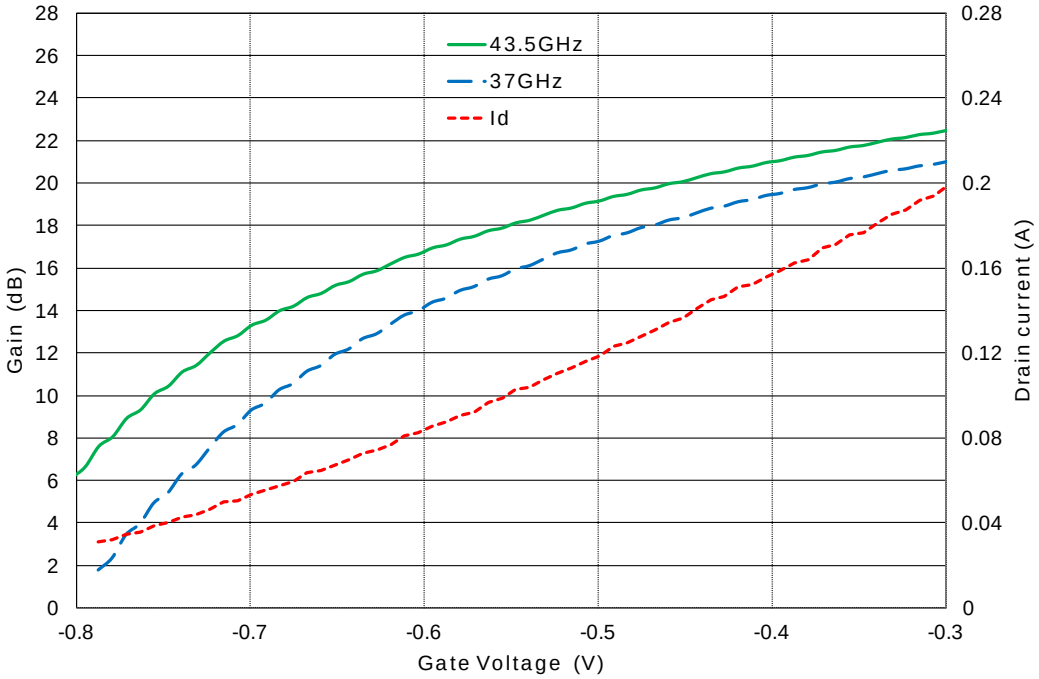
Typical Board Measurements

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



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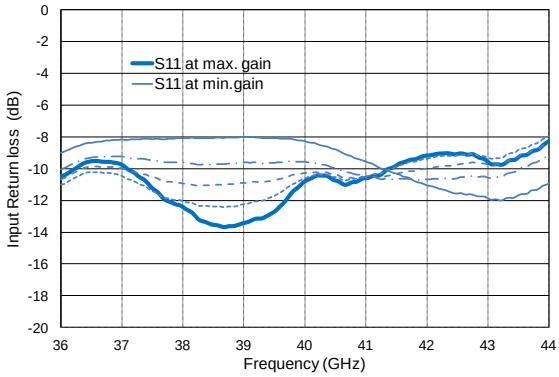
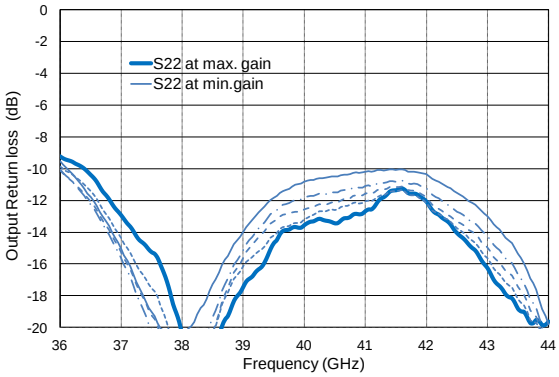
Typical Board Measurements

Tamb.= +25°C, Vd = +4.0V, Id = 200mA

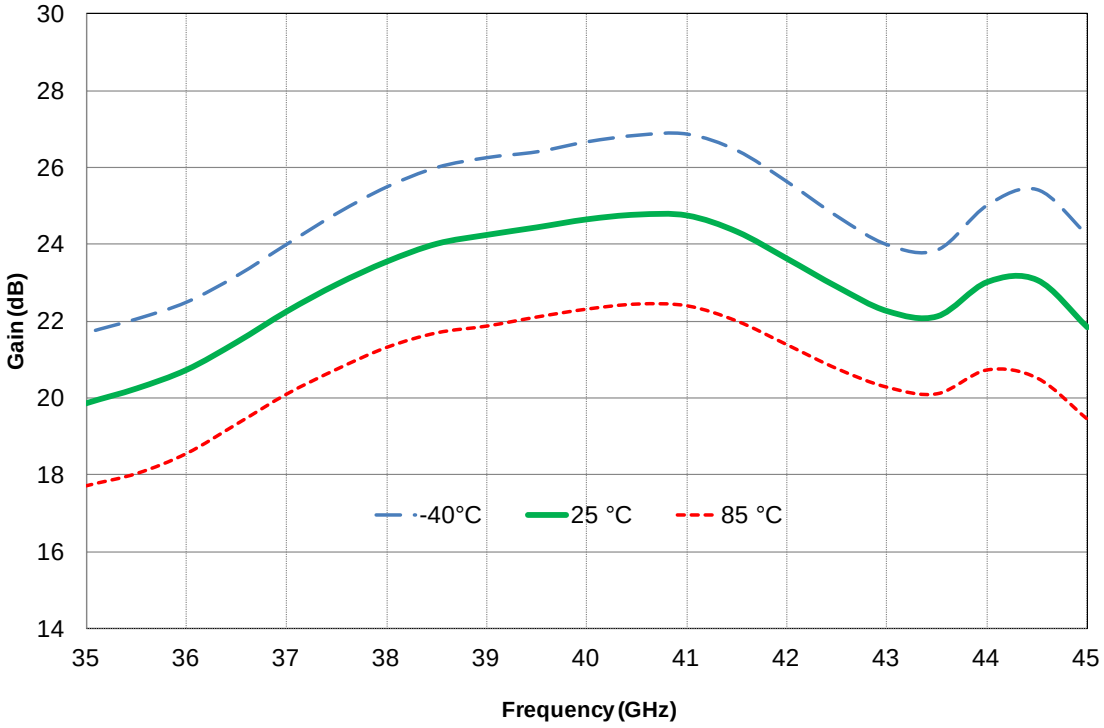
Input return loss versus Gain Control Voltage



Output return loss versus Gain Control Voltage



Linear Gain versus Frequency in Temperature



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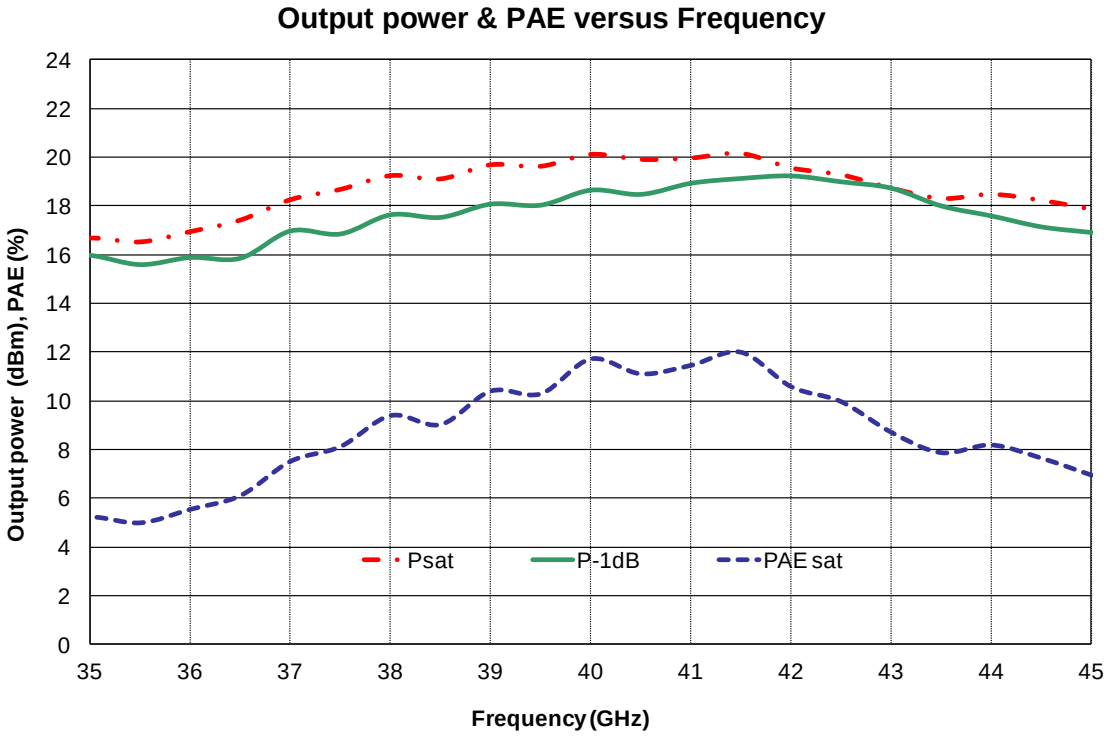
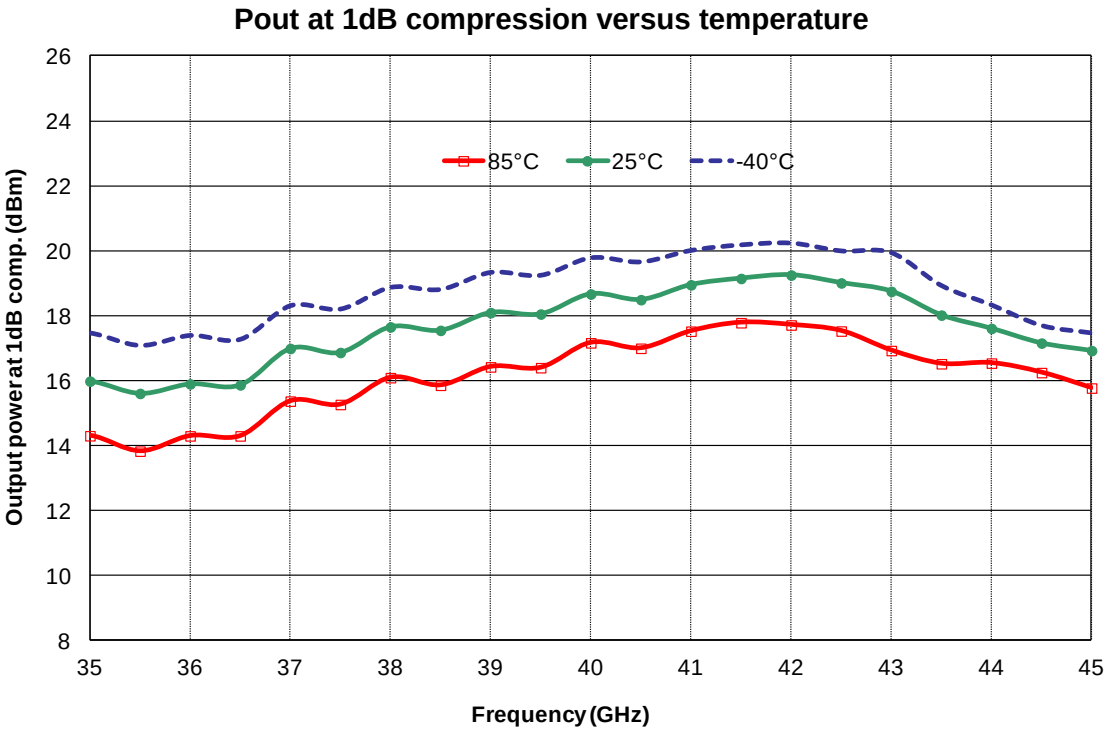
Typical Board Measurements

Tamb.= +25°C, Vd = +4.0V, Id = 200mA





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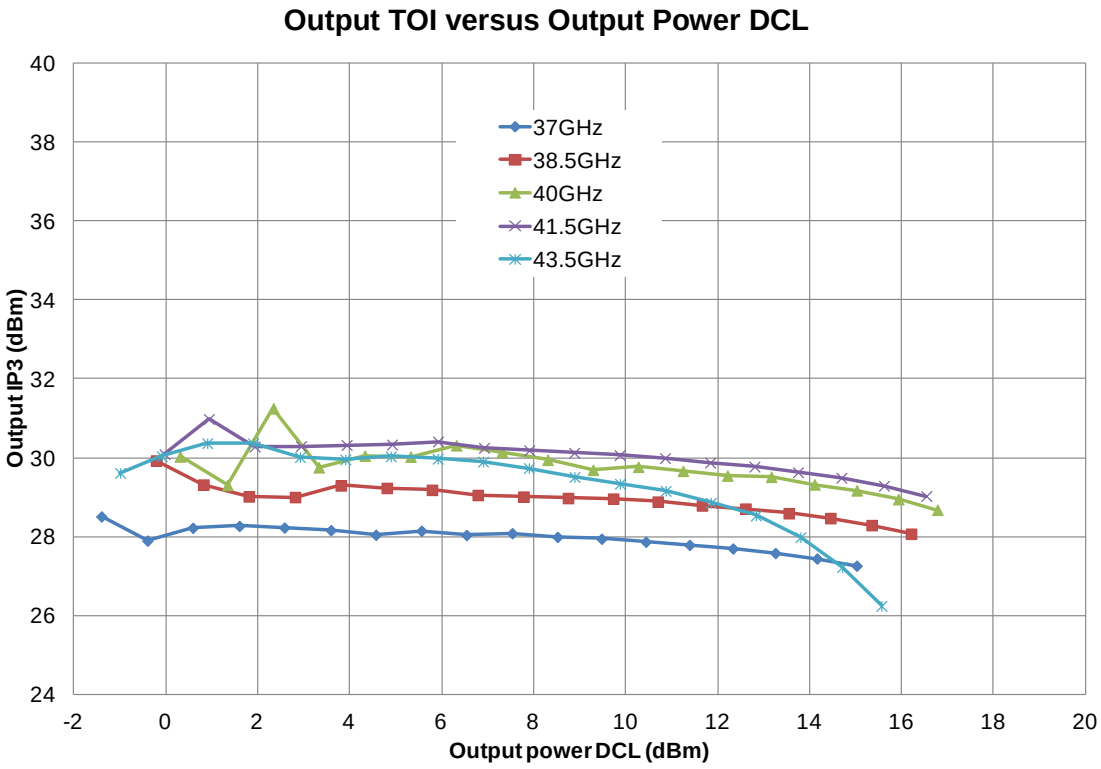
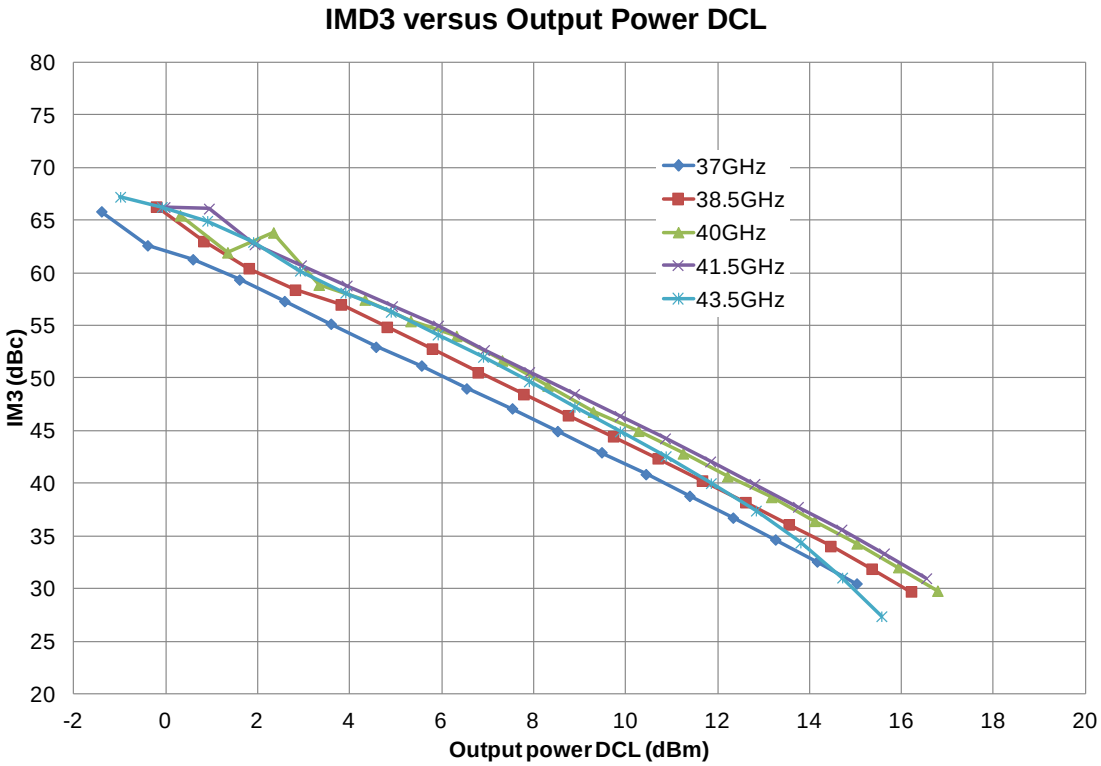
Typical Board Measurements

Tamb.= +25°C, Vd = +4.0V, Id = 200mA





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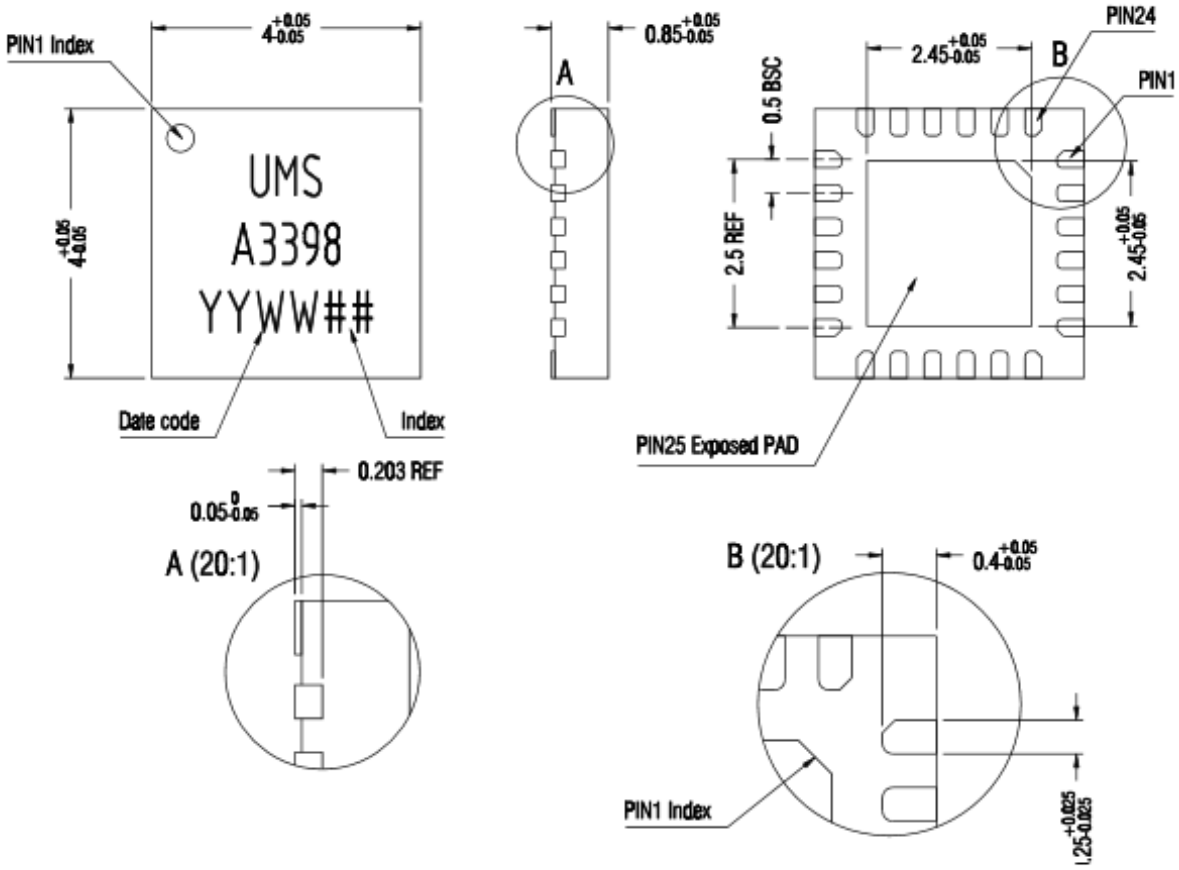
Package outline (1)



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.

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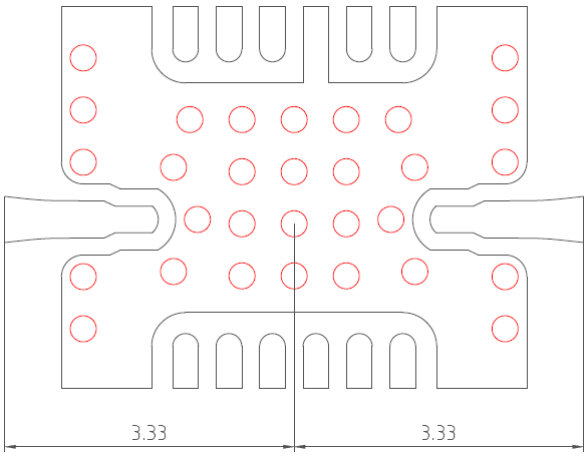
Definition of the Sij reference planes

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 mother board".



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

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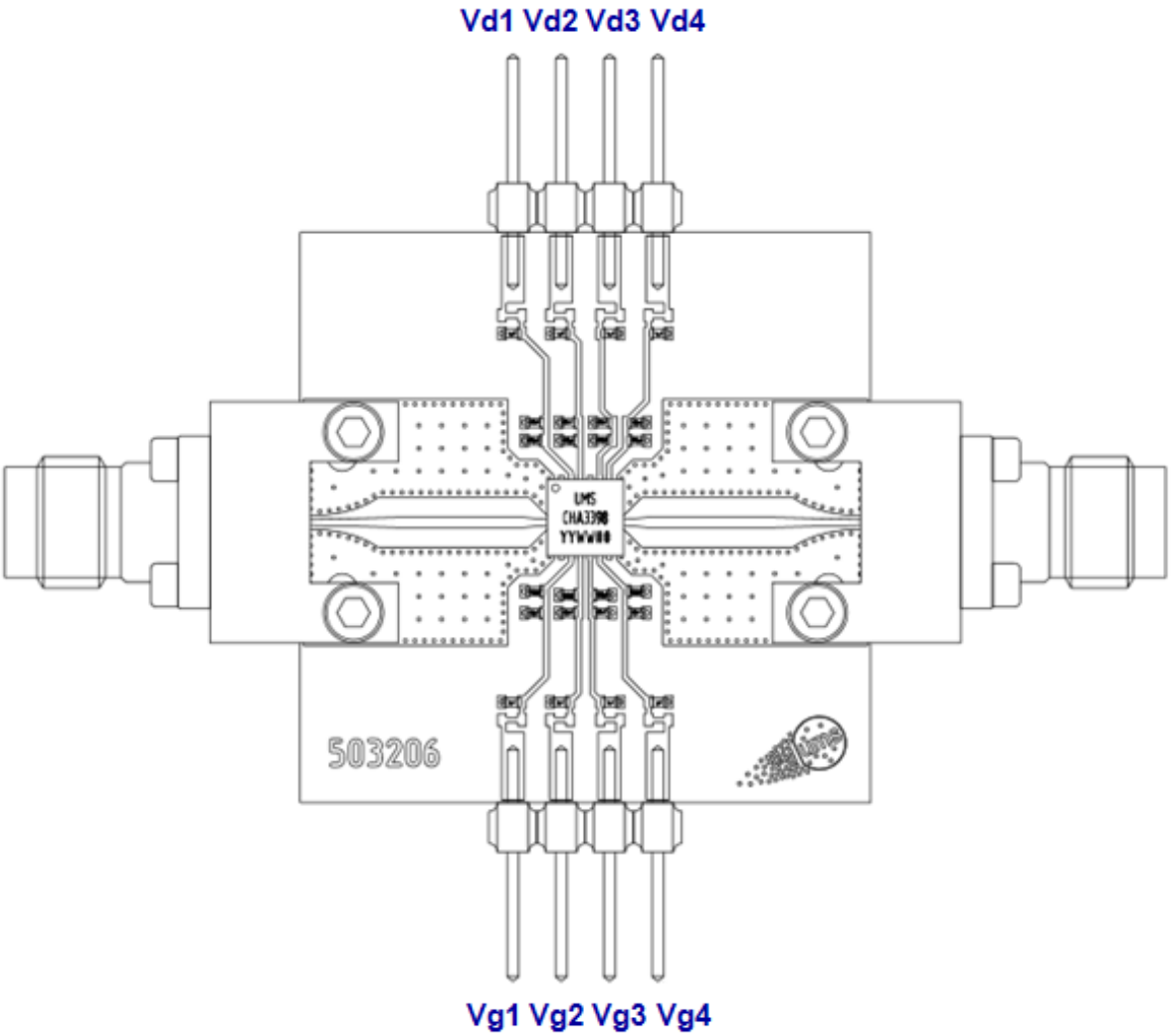
Evaluation mother board

- 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 ±5%, 10nF ±10% and 1µF ±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.

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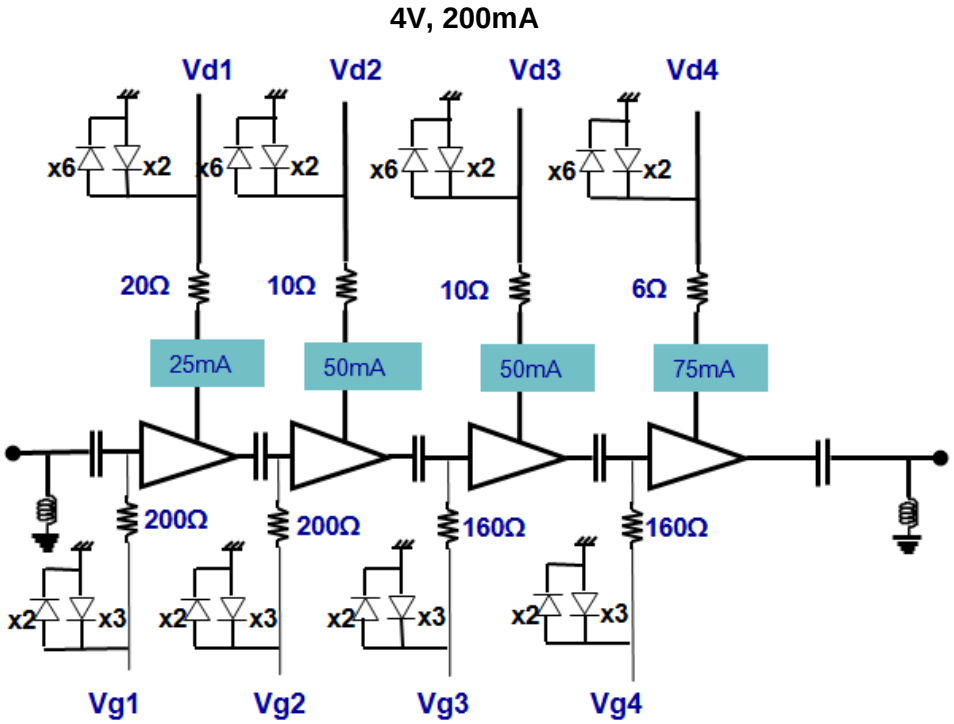
DC Schematic



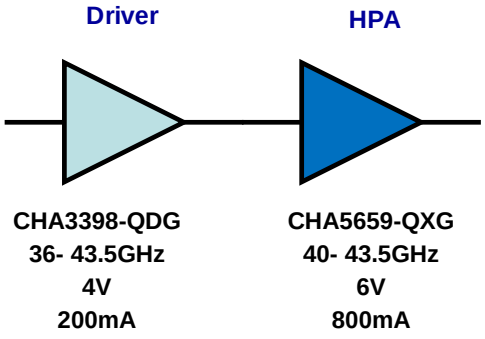
Notes

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.



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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 package products.

Ordering Information

QFN 4x4 package:	CHA3398-QDG/XY	
	Stick: XY = 20	Tape & reel: XY = 21

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