

PRELIMINARY DATASHEET

CGY2128UH/C2

24-34 GHz Ka-Band Low Noise Amplifier

DESCRIPTION

The CGY2128UH/C2 is a high performance Ka band Low Noise Amplifier. This device is a key component for high frequency systems.

The CGY2128UH/C2 is a three stage Low Noise Amplifier with a low power consumption (V_{dd}=3.5V, total Drain current = 46mA). It can be used as a replacement of CGY2128UH/C1 with identical RF performances, but easier management of Space Derating Rules.

The CGY2128UH/C2 has two sets of drain voltage pads, one for commercial grade use, the second one imbedding automatic derating for space grade use.

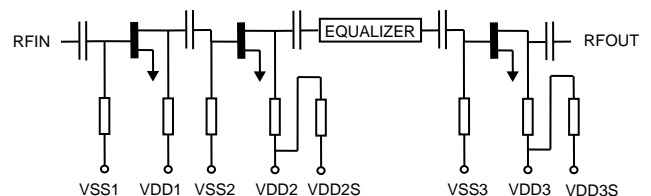
The MMIC is manufactured using OMMIC's proprietary 0.13 μ m Metamorphic HEMT D01MH technology which is registered in the European Preferred Part List (EPPL) from European Space Agency (ESA).

APPLICATIONS

- Space communications
- Ka band applications
- Instrumentation
- General purpose amplifier driver

FEATURES

- Operating frequency range : 24 to 34 GHz
- Small signal gain 23 dB at 29 GHz
- Low power consumption < 160mW
- Noise Figure 1.3 dB at 29 GHz
- Output P1dB 10 dBm at 29 GHz
- 50 Ohms input and output matched
- Input Return Loss: > 15 dB at 29GHz
- Output Return Loss: > 15 dB at 29GHz
- Die size = 2.64 x 2.0 mm
- Available
 - Production Tested, Inspected Known Good Die (KGD)
 - Samples available
 - Demonstration Boards available
 - Flight model



CGY2128UH/C2 Low Noise Amplifier Block Diagram



MAXIMUM VALUES

$T_{amb} = + 25\text{ }^{\circ}\text{C}$, unless otherwise specified.

Symbol	Parameter	Conditions	MIN.	MAX.	UNIT
$V_{SS1}, V_{SS2}, V_{SS3}$	Gate voltage	$V_{DDx}=0V$	- 2.0	+0.7	V
$V_{DD1}, V_{DD2}, V_{DD3}$	Drain voltage	$V_{SSx}\leq 0V$	0	+ 5.0	V
I_{DD1}	Drain Current	$V_{DDx}= 3.5\text{ V}$		16	mA
I_{DD2}	Drain Current	$V_{DDx}= 3.5\text{ V}$		26	mA
I_{DD3}	Drain Current	$V_{DDx}= 3.5\text{ V}$		50	mA
$I_{SS1}, I_{SS2}, I_{SS3}$	Gate Current	$V_{DDx}= 3.5\text{ V}$		10	mA
P_{IN}	RF Input power	CW		+ 10	dBm
T_j	Junction temperature	Space use		+ 110	$^{\circ}\text{C}$
T_j	Junction temperature	Commercial use		+ 150	$^{\circ}\text{C}$
T_{stg}	Storage temperature		- 55	+ 150	$^{\circ}\text{C}$

Operation of this device outside the parameter ranges given above may cause permanent damage. Combination of several limitations may be worse.

THERMAL CHARACTERISTICS

Symbol	Parameter	Value	UNIT
$R_{th(j-amb)}$	Thermal resistance from junction to ambient (DC power at T_{amb} max)	58	$^{\circ}\text{C/W}$

DC CHARACTERISTICS

$T_{amb} = + 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Symbol	Parameter	Conditions	MIN.	TYP.	MAX.	UNIT
$V_{DD1}, V_{DD2}, V_{DD3}$	Drain Supply voltage (commercial use, V_{DD2_S} and V_{DD3_S} left open)			+ 3.5		V
$V_{DD1}, V_{DD2_S}, V_{DD3_S}$	Drain Supply voltage (space use, V_{DD2} and V_{DD3} left open)			+ 3.5		V
I_{DD1}	First stage drain current	V_{SS1} Gate voltage tuned		8		mA
I_{DD2}	Second stage drain current	V_{SS2} Gate voltage tuned		13		mA
I_{DD3}	third stage drain current	V_{SS3} Gate voltage tuned		25		mA
$V_{SS1}, V_{SS2}, V_{SS3}$	Gate supply voltages	Tuning to reach typical DC current	-1.0	-0.7	+0	V



Caution : This device is a high performance RF component and can be damaged by inappropriate handling. Standard ESD precautions should be followed. OMMIC document "OM-CI-MV/ 001/ PG" contains more information on the precautions to take.

DESIGN INFORMATION

CGY2128UH/C2 has been developed to support space and commercial Ka band applications.

This is a 3 stage amplifier, matched to 50 Ohms taking into account 0.08nH and 0.15nH bonding wires at the input and output. The flat gain is obtained by the use of an equalizer located between the second and the third stage, to avoid internal mismatch creating peak voltages.

The RF part is exactly identical to the CGY2128UH/C1, while the CGY2128UH/C2 implements additional DC pads for an easy management of space deratings as is explained in section "Application Information".

RF CHARACTERISTICS

$T_{amb} = 25\text{ }^{\circ}\text{C}$,

(1) Commercial $V_{DD1} = V_{DD2} = V_{DD3} = 3.5\text{V}$, (V_{DD2_S} , V_{DD3_S} left open), $I_{D1} = 8\text{mA}$, $I_{D2} = 13\text{mA}$, $I_{D3} = 25\text{mA}$.

(2) Space $V_{DD1} = V_{DD2_S} = V_{DD3_S} = 3.5\text{V}$, (V_{DD2} , V_{DD3} left open), $I_{D1} = 8\text{mA}$, $I_{D2} = 13\text{mA}$, $I_{D3} = 25\text{mA}$.

The specifications mentioned below are measured on-wafer, using 50 Ω RF probes, no bonding

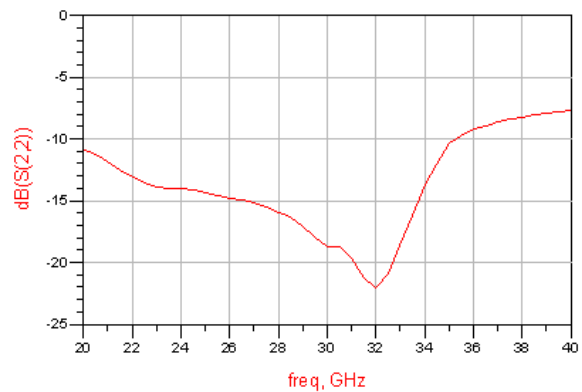
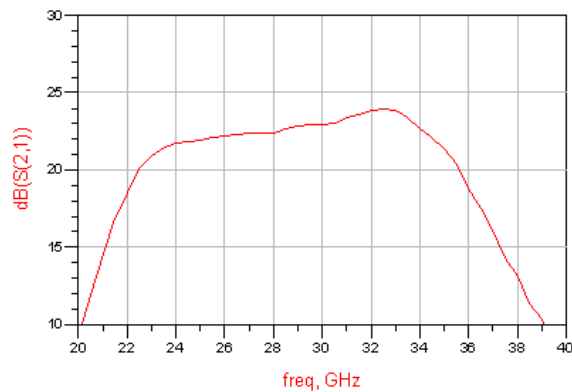
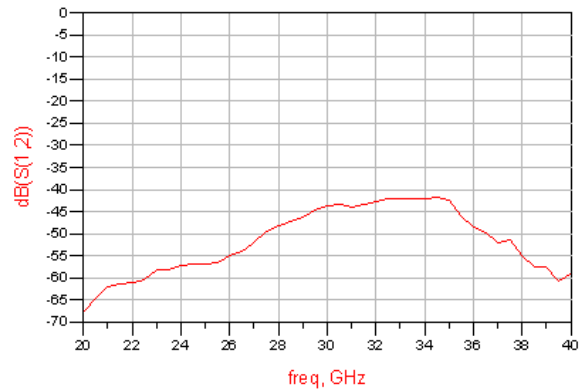
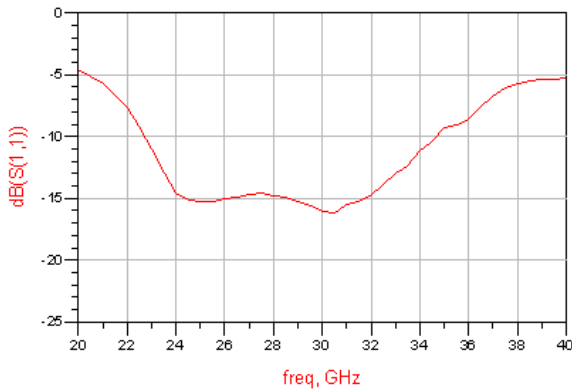
Symbol	Parameter	Conditions	MIN.	TYP.	MAX.	UNIT
BW	Bandwidth ⁽¹⁾⁽²⁾		24		34	GHz
Gain	Reference Gain ⁽¹⁾⁽²⁾	With bonding wires	19	23		dB
S11	Input Return Loss ⁽¹⁾⁽²⁾	With bonding wires		-16	-9	dB
S22	Output Return Loss ⁽¹⁾⁽²⁾	With bonding wires		-17	-9	dB
S12	Reverse Isolation ⁽¹⁾⁽²⁾	With bonding wires		-48		dB
NF	Noise Figure ⁽¹⁾⁽²⁾ on wafer*	@29GHz, No bonding*		1.6*	2*	dB
P1dB	Output 1dB compression point ⁽¹⁾	@29GHz, No bonding	9	10.5		dBm
P1dB	Output 1dB compression point ⁽²⁾	@29GHz, No bonding	7	8.5		dBm
OIP3	Third order Intermodulation ⁽¹⁾	2 SCL 100MHz Spacing, F1 = 27.95 Ghz, F2 = 28.05 GHz		19.5		dBm
OIP3	Third order Intermodulation ⁽²⁾	2 SCL 100MHz Spacing, F1 = 27.95 Ghz, F2 = 28.05 GHz		17.5		dBm

* = noise is improved by approximately 0.4 dB when mounted on carrier with bonding wires

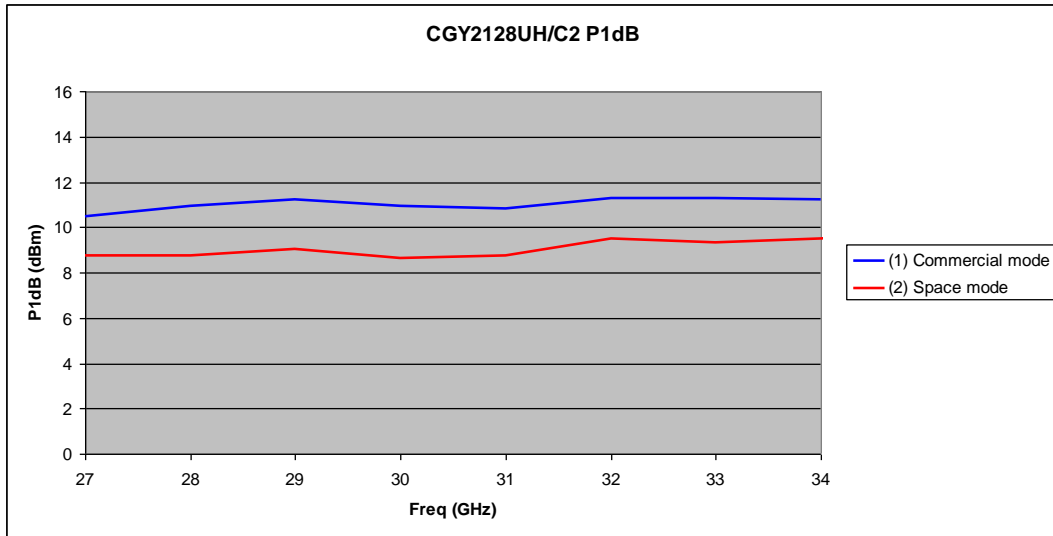
EXAMPLE OF MEASURED PERFORMANCES

Commercial (1) and Space (2) biasing modes have identical RF performances for S-parameters, Gain and Noise figure.

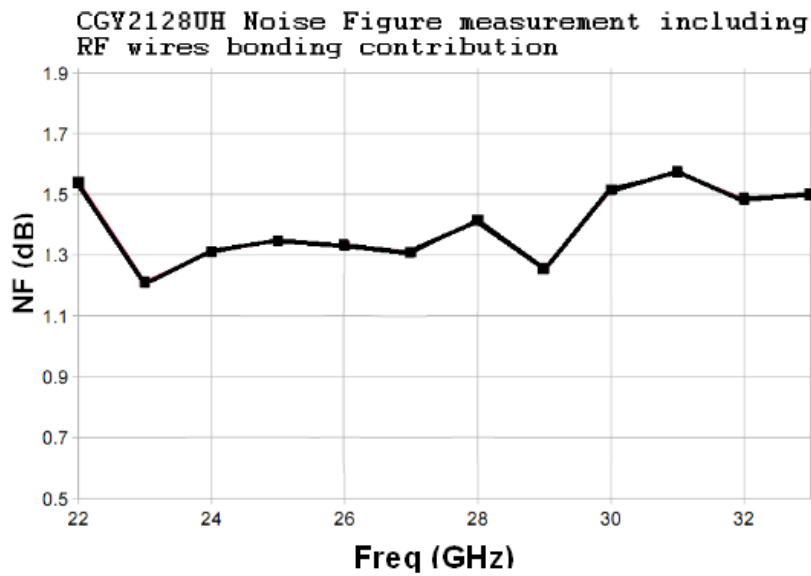
P1dB and OIP3 of Space mode (2) are 2 dB lower than commercial mode.



Typical S parameters of CGY2128UH/C2,
On wafer test, bonding wires added by calculation, 20fF/0.08nH 0.15nH/20fF



Typical P1dB of CGY2128UHC2, on wafer test, no bonding



Typical CGY2128UH/C2 Noise figure, board test

S parameter Table

CGY2128UH/C2 - on wafer test - input bonding 20fF/0.08nH, output bonding 0.15nH/20fF								
Freq (GHz)	S11M (dB)	S11P	S12M (dB)	S12P	S21M (dB)	S21P	S22M (dB)	S22P
20	-4.63	25.06	-67.71	47.59	9.24	156.52	-10.81	125.21
20.5	-5.13	9.95	-64.53	70.41	11.85	137.37	-11.28	113.52
21	-5.76	-6.44	-62.15	57.52	14.53	113.80	-11.87	101.58
21.5	-6.63	-24.23	-61.45	48.59	16.81	90.42	-12.51	90.34
22	-7.72	-42.15	-61.17	28.52	18.55	64.35	-13.07	79.74
22.5	-9.12	-60.12	-60.50	18.94	20.04	37.49	-13.56	69.00
23	-11.03	-77.07	-60.00	-4.14	20.91	12.29	-13.89	58.87
23.5	-13.00	-87.93	-60.00	-31.34	21.42	-13.78	-14.02	47.70
24	-14.56	-95.40	-60.00	-66.32	21.70	-36.87	-14.02	35.03
24.5	-15.14	-98.27	-60.00	-102.40	21.82	-58.12	-14.11	20.82
25	-15.24	-105.34	-60.00	-125.51	21.93	-78.58	-14.38	7.04
25.5	-15.29	-112.55	-60.00	-145.18	22.06	-98.10	-14.61	-6.62
26	-15.09	-120.24	-53.98	-158.92	22.16	-116.57	-14.80	-20.41
26.5	-14.94	-129.13	-53.98	-171.15	22.32	-135.00	-14.89	-34.96
27	-14.70	-138.15	-50.46	176.51	22.40	-153.28	-15.19	-50.09
27.5	-14.52	-149.50	-50.46	163.21	22.40	-170.79	-15.49	-65.92
28	-14.85	-158.58	-47.96	146.38	22.43	172.43	-15.92	-80.64
28.5	-14.94	-167.49	-47.96	133.81	22.64	156.23	-16.36	-96.03
29	-15.29	-176.98	-46.02	120.37	22.87	138.05	-17.08	-110.25
29.5	-15.60	172.97	-44.44	108.60	22.94	120.54	-17.92	-123.81
30	-16.08	163.88	-43.10	88.00	22.94	104.18	-18.71	-131.52
30.5	-16.19	156.65	-43.10	69.56	23.06	87.13	-18.71	-140.95
31	-15.49	142.44	-44.44	59.44	23.42	70.34	-19.58	-154.16
31.5	-15.19	124.99	-43.10	50.11	23.60	52.39	-21.21	-159.10
32	-14.66	105.02	-43.10	38.46	23.83	32.89	-22.05	-151.54
32.5	-13.94	80.78	-41.94	23.95	23.89	12.96	-20.92	-143.01
33	-13.00	56.25	-41.94	7.40	23.81	-8.16	-18.64	-141.11
33.5	-12.43	32.72	-41.94	-2.12	23.38	-29.36	-16.19	-140.99
34	-11.18	11.48	-41.94	-20.48	22.66	-48.96	-13.68	-153.43
34.5	-10.37	-7.07	-41.94	-36.47	22.13	-69.06	-12.08	-163.26
35	-9.32	-25.05	-41.94	-64.48	21.36	-89.10	-10.37	-177.43
35.5	-9.07	-40.01	-46.02	-85.11	20.34	-110.00	-9.74	168.47
36	-8.57	-48.96	-47.96	-91.02	18.78	-129.96	-9.22	156.33
36.5	-7.60	-57.96	-50.46	-93.04	17.52	-146.66	-8.92	146.57
37	-6.80	-68.84	-50.46	-101.15	16.12	-163.27	-8.59	137.16
37.5	-6.11	-79.24	-50.46	-103.19	14.28	-177.94	-8.40	128.40
38	-5.75	-89.75	-53.98	-128.83	13.10	167.52	-8.20	121.24
38.5	-5.51	-98.23	-60.00	-128.16	11.36	154.05	-8.07	114.12
39	-5.40	-106.62	-60.00	-137.57	10.29	140.51	-7.94	108.47
39.5	-5.34	-114.17	-60.62	-159.36	8.34	128.16	-7.85	102.57
40	-5.32	-120.21	-60.00	-153.07	6.46	119.26	-7.64	97.41

APPLICATION INFORMATION

Commercial use (1):

For commercial use, with no derating, the CGY2128UH/C2 must be used as follows:

- $V_{DD1}=V_{DD2}=V_{DD3}=+3.5V$.
- V_{SS1} , V_{SS2} , and V_{SS3} tuned to reach the nominal DC currents of 8mA, 13mA and 25mA.
- V_{DD2_S} and V_{DD3_S} left open (no connection).

Space use (2):

For space use, including derating, the CGY2128UH/C2 must be used as follows:

- $V_{DD1}=V_{DD2_S}=V_{DD3_S}=+3.5V$.
- V_{SS1} , V_{SS2} , and V_{SS3} tuned to reach the nominal DC currents of 8mA, 13mA and 25mA.
- V_{DD2} and V_{DD3} left open (no connection).

In these conditions, no additional derating on biasing voltage or current has to be applied, the derating is build-in the circuit. Using the V_{DD2_S} and V_{DD3_S} pads applies automatically the correct deratings to the individual transistors through internal voltage drop resistors.

GENERAL APPLICATION INFORMATION

Typical application scheme:

A reference device environment layout is proposed below. In this figure 1, RF input and output microstrip transmission lines are used, but coplanar transmission lines with similar performance may also be used. All path lengths and physical sizes of the components should be minimized.

RF input bonding inductances should be minimized to give the best performance. Overall wire length should be kept as small as possible to reduce parasitic inductance. Higher RF input / output inductance may result in a degradation of gain and match. Ribbon bonding technique can also be used. The target inductance at the input is 0.08nH, corresponding to 2 wires of 180um length.

RF output bonding inductances should be minimized to give the best performance. Overall wire length should be kept as small as possible to reduce parasitic inductance. Higher RF input / output inductance may result in a degradation of gain and match. Ribbon bonding technique can also be used. The target inductance at the output is 0.15nH, corresponding to 1 wire of 180um length.

All others bonding inductances (pads V_{DD1} , V_{DD2} , V_{DD2_S} , V_{DD3} , V_{DD3_S} and V_{SS1} , V_{SS2} , V_{SS3}) should be kept as short as possible.

Decoupling 47 pF chip capacitors (close to the chip) and 10 nF chip capacitors are used to improve the power supply rejection. High value, additional decoupling capacitor in SMD format can be added

The chip itself has via holes connecting the front side to the back side of the chip. A good RF grounding connection should be maintained between the backside of the chip and system ground. It is extremely

important to use an uninterrupted ground plane. AuSn eutectic soldering or silver conductive epoxy material can be used for die attachment.

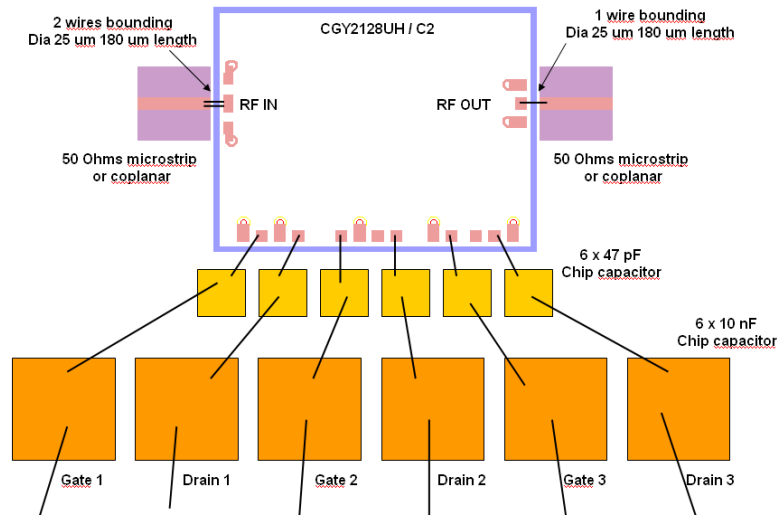


Figure 1: CGY2128UH/C2 commercial application mounting scheme

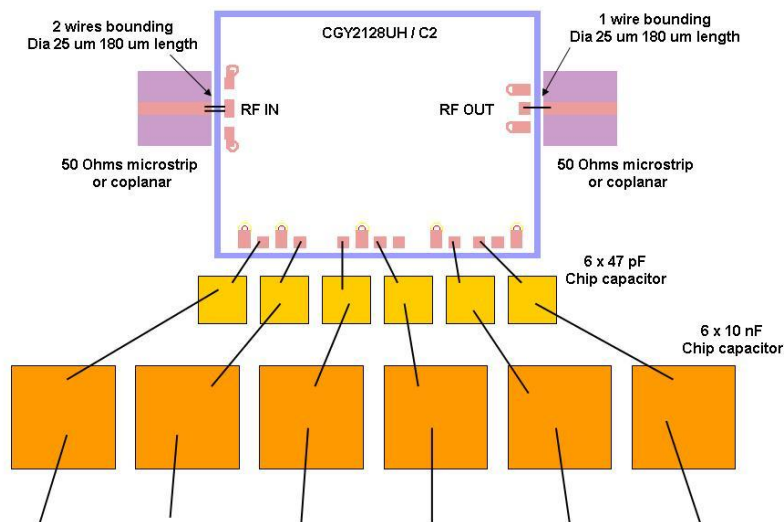


Figure 2: CGY2128UH/C2 Space application mounting scheme

OPERATING AND HANDLING INSTRUCTIONS

The CGY2128UH/C2 is very high performance MHEMT device and as such, care must be taken at all times to avoid damage due to inappropriate handling, mounting, packaging and biasing conditions.

1- Power Supply Sequence

The following power supply sequences are recommended:

Power up

1. Make sure the transient peaks from DC supply voltages do not exceed the limiting values.
2. Set V_{DD1} , V_{DD2} (or V_{DD2S}) and V_{DD3} (or V_{DD3S}) to 0V
3. Pinch off the device by setting V_{SS1} , V_{SS2} , V_{SS3} to -1 V (gate current must be near 0 mA).
4. Increase V_{DD1} , V_{DD2} (or V_{DD2S}) and V_{DD3} (or V_{DD3S}) to 3.5V (drain current must stay near 0 mA)
5. Increase the gate voltages V_{SS1} , V_{SS2} and V_{SS3} slowly from -1 V until the three drains current stages reaches respectively 8mA, 13mA and 25mA.
6. Apply the RF input signal.

Power down

1. Remove RF input signal
2. Pinch off the device by setting V_{SS1} , V_{SS2} , V_{SS3} to -1 V (gate and drain current must be near 0 mA).
3. Set V_{DD1} , V_{DD2} (or V_{DD2S}) and V_{DD3} (or V_{DD3S}) to 0V
4. Set V_{SS1} , V_{SS2} and V_{SS3} to 0V

2- Mounting and ESD handling precautions

For high performance Integrated Circuits, such as CGY2128UH/C2, care must be taken when mounting GaAs MMICs so as to correctly mount, bond and subsequently seal the packages and hence obtain the most reliable long-term operation. The temperature, duration, material and sealing techniques compatible with GaAs MMICs and the precautions to be taken are described in OMMIC's document "OM-CI-MV/001/PG", entitled, "Precautions for use III-V products".

PAD LAYOUT

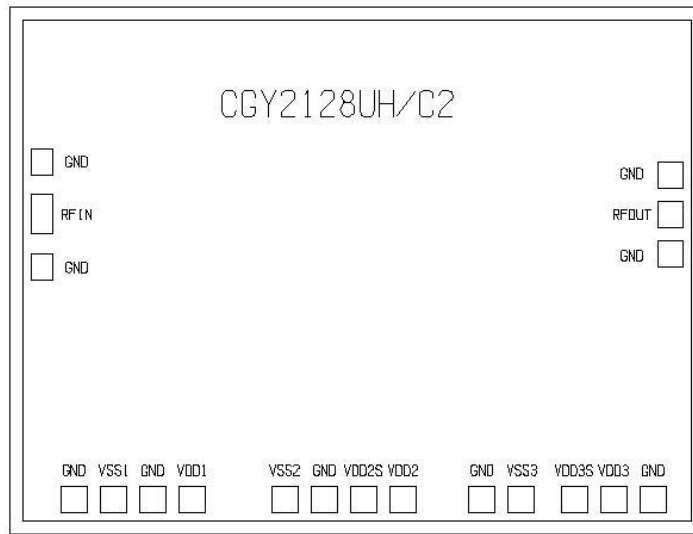


Figure 3: CGY2128UH/C2 Pad layout

PAD COORDINATES

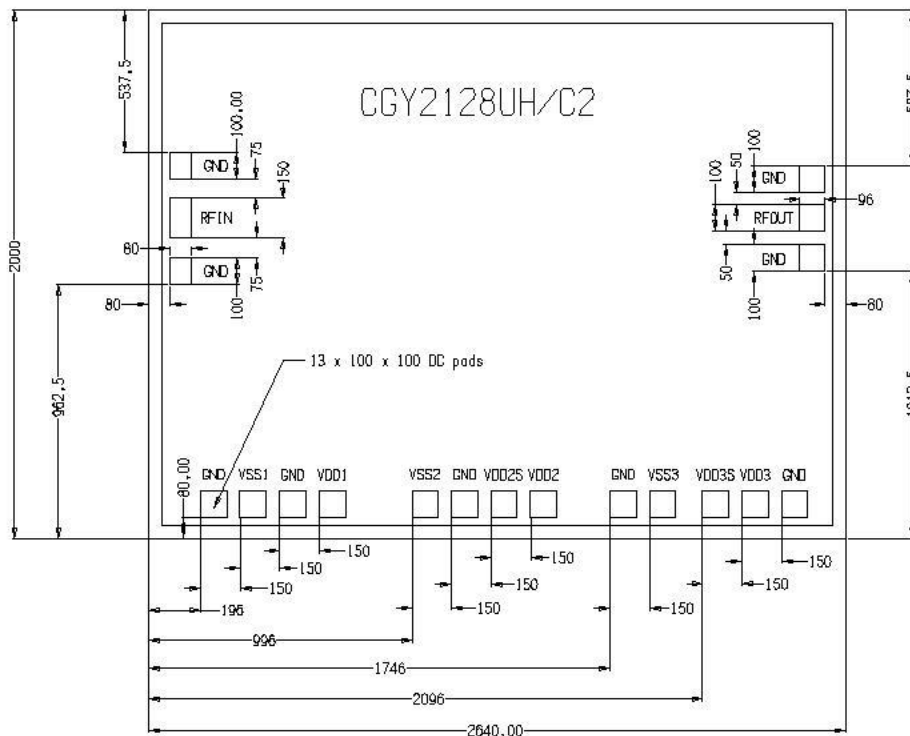


Figure 4: CGY2128UH/C2 pad coordinates

PAD POSITION

SYMBOL	PAD	COORDINATES		PAD SIZE	DESCRIPTION
		X	Y		
GND	1	122	1013	80 x 100	Connected to backside using via hole
RF IN	2	121	1213	80 x 150	RF input (RF probe pitch 200um)
GND	3	122	1413	80 x 100	Connected to backside using via hole
GND	4	245	130	100 x 100	Connected to backside using via hole
V _{SS1}	5	395	130	100 x 100	Gate supply 1
GND	6	545	130	100 x 100	Connected to backside using via hole
V _{DD1}	7	695	130	100 x 100	Drain supply 1
V _{SS2}	8	1046	130	100 x 100	Gate supply 2
GND	9	1195	130	100 x 100	Connected to backside using via hole
V _{DD2}	10	1345	130	100 x 100	Commercial Drain supply 2
V _{DD2S}	11	1495	130	100 x 100	Space application Drain supply 2
GND	12	1795	130	100 x 100	Connected to backside using via hole
V _{SS3}	13	1945	130	100 x 100	Gate supply 3
V _{DD3S}	14	2145	130	100 x 100	Space application Drain supply 3
V _{DD3}	15	2295	130	100 x 100	Commercial Drain supply 3
GND	16	2445	130	100 x 100	Connected to backside using via hole
GND	17	2512	1063	100 x 100	Connected to backside using via hole
RF OUT	18	2512	1213	100 x 100	RF Output (RF probe pitch 150um)
GND	19	2512	1363	100 x 100	Connected to backside using via hole

MECHANICAL INFORMATION

PARAMETER		DESCRIPTION
Size		2640 x 2000 mm
Thickness		100 μm
Backside material		TiAu
Passivation		PECVD deposition Si ₃ N ₄
Boundings pad dimensions	GND	100 x 100 μm
	RF OUT, V _{DD3} , V _{DD3S} , V _{DD2} , V _{DD2S} , V _{DD1} , V _{SS3} , V _{SS2} , V _{SS1}	100 x 100 μm
	RF IN	80 x 150 μm

Note

The die size and all pad positions refer to the mask layout, with (X=0, Y=0) at the bottom left corner of the layout. For each pad, the (X,Y) coordinates refer to the center of the pad.

Wafers are diced by sawing, with a sawline width of 35 μm (± 5 μm). A misalignment of the sawline with the middle of the dicing street (± 20 μm on all sides) may also result in a variation of ± 20 μm of the actual positions of the pads on the diced chip and an additional tolerance of ± 40 μm on the die size.

PACKAGE

Type	Description	Terminals	Pitch (mm)	Package size (mm)
DIE	100% RF and DC on-wafer tested	23	-	2.64 x 2.0 x 0.1

SOLDERING

To avoid permanent damages or impact on reliability during soldering process, die temperature should never exceed 330°C.

Temperature in excess of 300°C should not be applied to the die longer than 1mn

Toxic fumes will be generated at temperatures higher than 400°C

ORDERING INFORMATION

Generic type	Package type	Version	Sort Type	Description
CGY2128	UH	C2	-	On-Wafer measured Die



Caution : This device is a high performance RF component and can be damaged by inappropriate handling. Standard ESD precautions should be followed. OMMIC document "OM-CI-MV/ 001/ PG" contains more information on the precautions to take.



DEFINITIONS

Limiting values definition

Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

Application information

Applications that are described herein for any of these products are for illustrative purposes only. OMMIC makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

DISCLAIMERS

Life support applications

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