PRODUCT DATASHEET

CGY2160UH/C1

1.5-47GHz Wideband Amplifier

DESCRIPTION

The CGY2160UH is a distributed wide band amplifier designed to operate from 1.5 GHz to 47 GHz and includes on chip biasing networks.

This device offers a very wide band performance (1.5 – 47 GHz), low noise performance (2.5 dB noise figure at mid-band) while maintaining a good P1dB compression point (17 dBm at 10 GHz).

The on chip bias network includes a current control function which maintains the device operating close to the nominal biasing point over temperature and component dispersion.

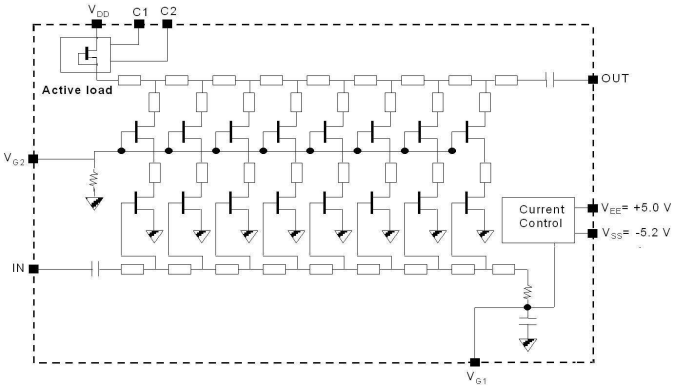
The MMIC is manufactured using OMMIC's qualified 0.13 µm PHEMT GaAs D01PH technology. The D01PH process is one of the European Space Agency (ESA) european preferred part list (EPPL) technologies.

APPLICATIONS

- Instrumentation
- EW Systems
- 43 Gb/s OC-768 EAM Driver
- General purpose very wide band amplifier

FEATURES

- Wide frequency range : 1.5 – 47 GHz
- 14.5 dB small signal gain
- Variable Gain Control
- Output P_{1dB} ≈ 17 dBm @ 10 GHz
- NF = 2.5 dB @ 10 GHz
- +5.0 V ; -5.2 V DC supply voltages
- Power consumption ≈ 500 mW
- On chip biasing networks
- Chip size = 1490 x 2580 µm
- Tested, Inspected Known Good Die (KGD)
- Samples Available
- Space and MIL-STD Available



Block Diagram of the CGY2160UH Broadband Amplifier

RoHS Compliant

LIMITING VALUES

Tamb = 25 °C unless otherwise noted

Symbol	Parameter	Conditions	MIN.	MAX.	UNIT
V_{DD}	Positive supply voltage		-0.5	+8	V
V_{EE}	Positive supply voltage, used for pinch off and temperature control		-0,5	+8	V
V_{SS}	Negative supply voltage, used for pinch off and temperature control		-6	0	V
V_{G2}	Second gate voltage		-0.5	3	V
I_{DD}	Supply current			150	mA
P_{in}	CW input power	See note 1		+17	dBm
T_{stg}	Storage temperature		-55	+150	° C
T_j	Junction temperature			+150	° C
R_{th}	Thermal Resistance			48	°C/W

NOTE

1-When P_{in} = + 17 dBm is applied at the input of the device for 15 min no performance degradation is observed after power exposure.

OPERATING CONDITIONS

Symbol	Parameter	Conditions	MIN.	TYP.	MAX.	UNIT
V_{DD}	Positive supply voltage		+ 4.75	+ 5.0	+ 5.25	V
V_{EE}	Positive supply voltage, used for pinch off and temperature control			+ 5.0		V
V_{SS}	Negative supply voltage, used for pinch off and temperature control			-5,2		V
V_{G2}	Second gate voltage	V_{DD}=5.0 V	-0,2		0,2	V
I_{DD}	Supply current				150	mA

DC CHARACTERISTICS

T_{amb} = 25 °C, V_{DD} = 5 V

Symbol	Parameter	Conditions	MIN.	TYP.	MAX.	UNIT
I_{DD}	Drain supply current		65	80	95	mA
I_{EE}	DC supply current		9	13	15	mA
I_{SS}	DC supply current		7	10	12	mA

AC CHARACTERISTICS

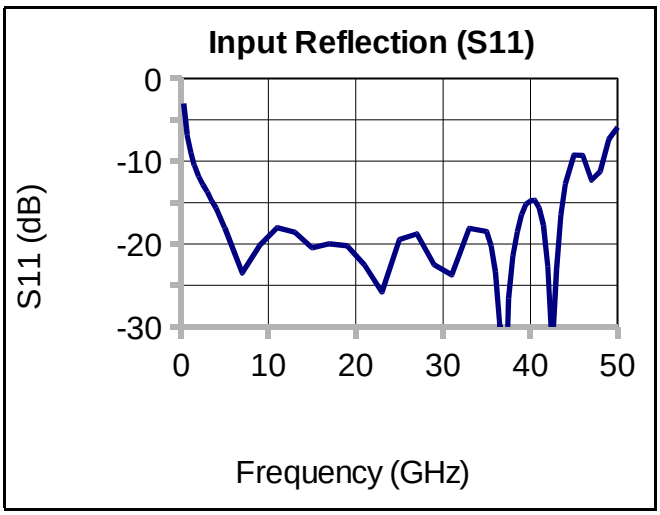
T_{amb} = 25 °C, V_{DD} = 5 V, V_{EE} = 5 V, V_{SS} = -5.2 V, I_{DD} = 80 mA, R_L = 50 Ω; The specifications mentioned below are measured on-wafer, using 50 Ω RF probes. Unless otherwise specified.

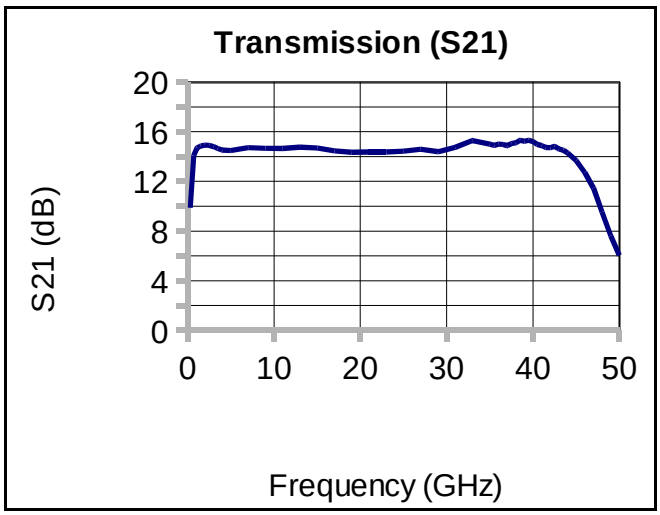
Symbol	Parameter	Conditions	MIN.	TYP.	MAX.	UNIT
BW			1,5		47	GHz
S21	Reference Gain	F = 5 GHz	13,5	14,5	16,5	dB
F_C	High frequency cut-off	$Gain_{5GHz}$ – 3dB	43	47	50	GHz
ΔS21	Small signal gain flatness	F = 1.5 GHz to 30 GHz	-1		1	dB
		F = 30 GHz to 40 GHz			2,5	dB
		F = 40 GHz to F_C	-3			dB
S11	Input return loss	F = 1.5 GHz to 5 GHz		-10.0	-8	dB
		F = 5 GHz to 35 GHz		-17	-13	dB
		F = 35 GHz to 40 GHz		-15	-10	dB
		F = 40 GHz to 45 GHz			-3	dB
		F = 45 GHz to 65 GHz			-0,5	dB
S22	Output return loss	F = 1.5 GHz to 3 GHz		-15	-9	dB
		F = 3 GHz to 30 GHz		-13	-11	dB
		F = 30 GHz to 50 GHz		-12	-10	dB
		F = 50 GHz to 65 GHz			-0,5	dB
NF	Noise Figure	F = 2 GHz to 4 GHz		3,5		dB
		F = 4 GHz to 20 GHz		2,5		dB
		F = 20 GHz to 29 GHz		3,5		dB
		F = 29 GHz to 36 GHz		4,5		dB
P1dB	Output P1dB	F = 10 GHz		17		dBm
		F = 20 GHz		16		dBm
K	Microwave stability factor.	All passive source and loads	1,4			

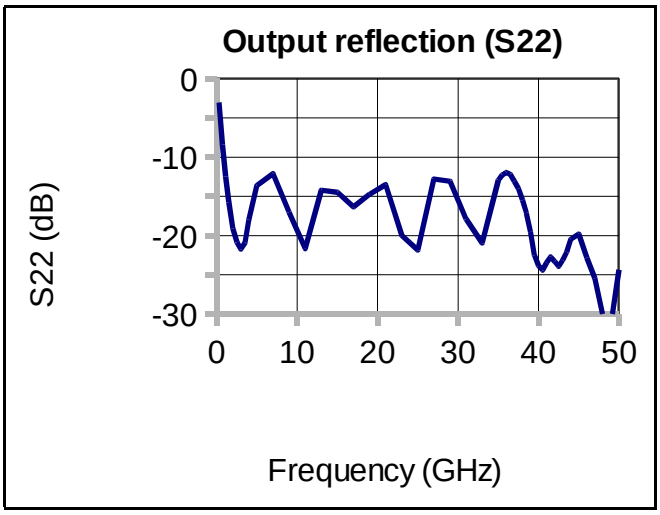
Caution : This device is a high performance RF component and can be damaged by inappropriate handling. Standard ESD precautions should be followed. OMMIC document "OM-CI-MV/ 001/ PG" contains more information on the precautions to take.

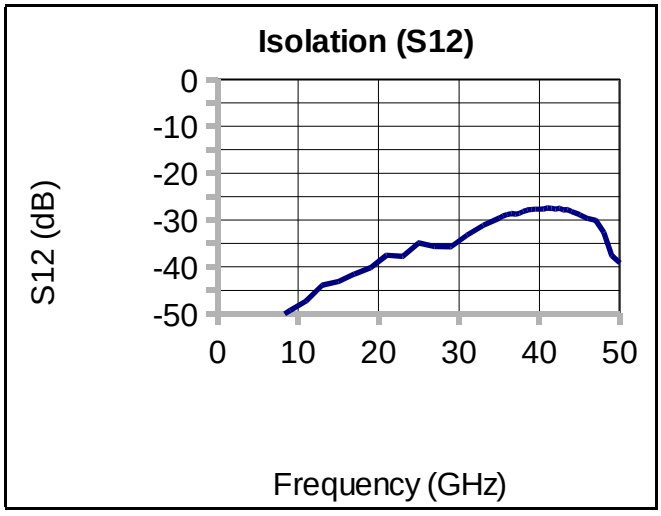
MEASURED PERFORMANCE

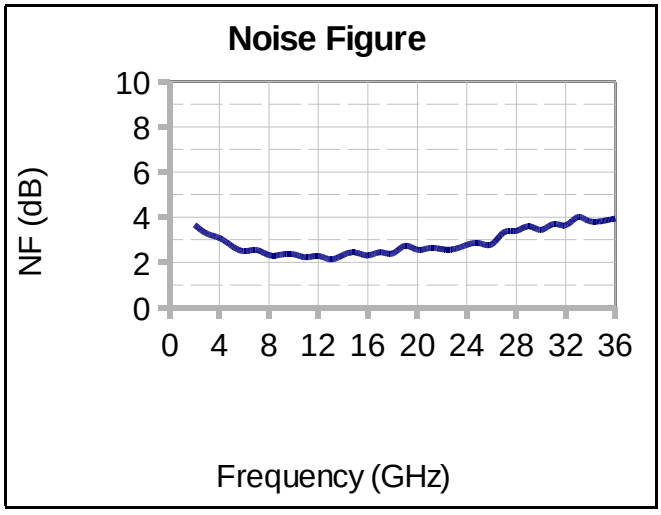
T_{amb} = 25°C; V_{DD} = 5.0 V; V_{EE} = +5.0 V; V_{SS} = -5.2 V. The S-Parameter data presented is measured using high frequency RF probes. DC biasing is provided via DC biasing networks that include suitable decoupling capacitors.

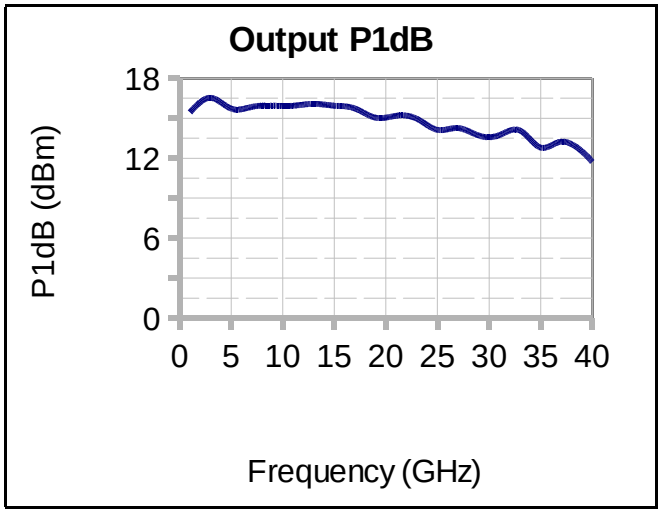












CGY2160UH/C1 TYPICAL SCATTERING PARAMETERS

T_{amb} = 25°C, V_{DD} = +5.0 V, V_{EE} = 5.0 V, V_{SS} = -5.2 V, I_{DD} = 80 mA, R_L = 50 Ω.

Frequency (GHz)	Mag S11	Ang S11 (°)	Mag S21	Ang S21 (°)	Mag S12	Ang S12 (°)	Mag (S22)	Ang S22 (°)
0.3	-3.02	-37.62	9.881	-96.44	-69.88	162.4	-3.027	-43.4
0.7	-6.831	-51.42	14.07	-150.8	-58.89	95.14	-8.427	-62.07
1.1	-8.986	-58.36	14.7	-175.6	-55.65	57.09	-12.45	-66.13
1.5	-10.46	-64.38	14.84	167.8	-54.44	34.04	-15.74	-64.38
2	-11.83	-71.36	14.92	151.7	-55.02	10.24	-19.1	-51.44
2.5	-12.83	-79.33	14.9	137.4	-55.73	-2.742	-20.84	-35.51
3	-13.7	-88.62	14.8	124.2	-55.98	-2.572	-21.72	-17.66
3.5	-14.79	-98.76	14.66	112.3	-54.92	-27.61	-20.91	4.993
4	-15.66	-110.3	14.52	101.3	-58.48	-28.95	-17.97	16.09
5	-18.05	-139.1	14.49	80.2	-59.6	3.552	-13.6	5.871
7	-23.5	122	14.72	36.64	-51.36	-31.11	-12.09	-34.66
9	-20.16	17.31	14.67	-7.392	-49.3	-56.77	-17.01	-66.34
11	-18.02	-49.36	14.66	-50.48	-47.32	-93.41	-21.66	-11.5
13	-18.57	-115.1	14.76	-93.8	-43.91	-125	-14.22	-20.29
15	-20.45	164.3	14.69	-138.2	-43.14	-163.5	-14.47	-46.83
17	-19.98	78.7	14.46	177.8	-41.53	162.3	-16.34	-48.42
19	-20.21	3.304	14.35	134.6	-40.2	133.5	-14.73	-49.99
21	-22.53	-79.11	14.37	91.81	-37.52	78.04	-13.5	-76.9
23	-25.8	158.8	14.37	46.9	-37.74	49.05	-19.97	-107.4
25	-19.46	69.79	14.43	2.235	-34.89	12.39	-21.86	-3.818
27	-18.78	-2.447	14.59	-43.89	-35.65	-38.81	-12.78	-43.9
29	-22.51	-70.28	14.39	-89.32	-35.69	-74.05	-13.06	-80.61
31	-23.73	165.4	14.74	-134.6	-33.23	-110.3	-17.89	-110.1
33	-18.11	80.23	15.29	173.7	-31.16	-160.6	-20.95	-28.43
35	-18.51	21.23	15.01	121.7	-29.59	149.9	-12.93	-56.66
35.5	-20.22	6.44	14.91	109.5	-29.12	136.6	-12.26	-67.76
36	-23.38	-9.562	15	97.54	-28.82	123.4	-11.95	-78.84
36.5	-29.86	-16.57	14.97	84.03	-28.6	109.9	-12.18	-91.32
37	-44.12	84.02	14.88	71.74	-28.75	96.81	-13.06	-102.6
37.5	-26.56	119.8	15.04	59.57	-28.57	86.44	-14.01	-111.5
38	-21.45	108.3	15.1	46.28	-28.16	75.53	-15.46	-119.7
38.5	-18.52	95.53	15.31	32.73	-27.87	62.95	-17.13	-125
39	-16.43	83.37	15.24	17.98	-27.73	49.17	-19.53	-130.5
39.5	-15.2	69.39	15.3	3.601	-27.69	36.91	-22.5	-122.7
40	-14.79	56.67	15.2	-11.16	-27.67	23.78	-23.82	-111.5
40.5	-14.7	42.87	14.98	-25.59	-27.65	11.86	-24.4	-94.63
41	-15.62	28.84	14.88	-39.45	-27.43	-0.9687	-23.46	-86.63
41.5	-17.73	14.29	14.73	-53	-27.49	-15.47	-22.71	-85.02
42	-22.7	6.105	14.72	-67	-27.65	-28.05	-23.27	-89.08
42.5	-32.85	30.98	14.81	-82.09	-27.49	-41.89	-23.93	-76.89
43	-23.03	129.1	14.6	-97.9	-27.86	-56.87	-23.15	-69.45
43.5	-16.47	120.8	14.52	-113.5	-27.77	-71	-22.11	-66.25

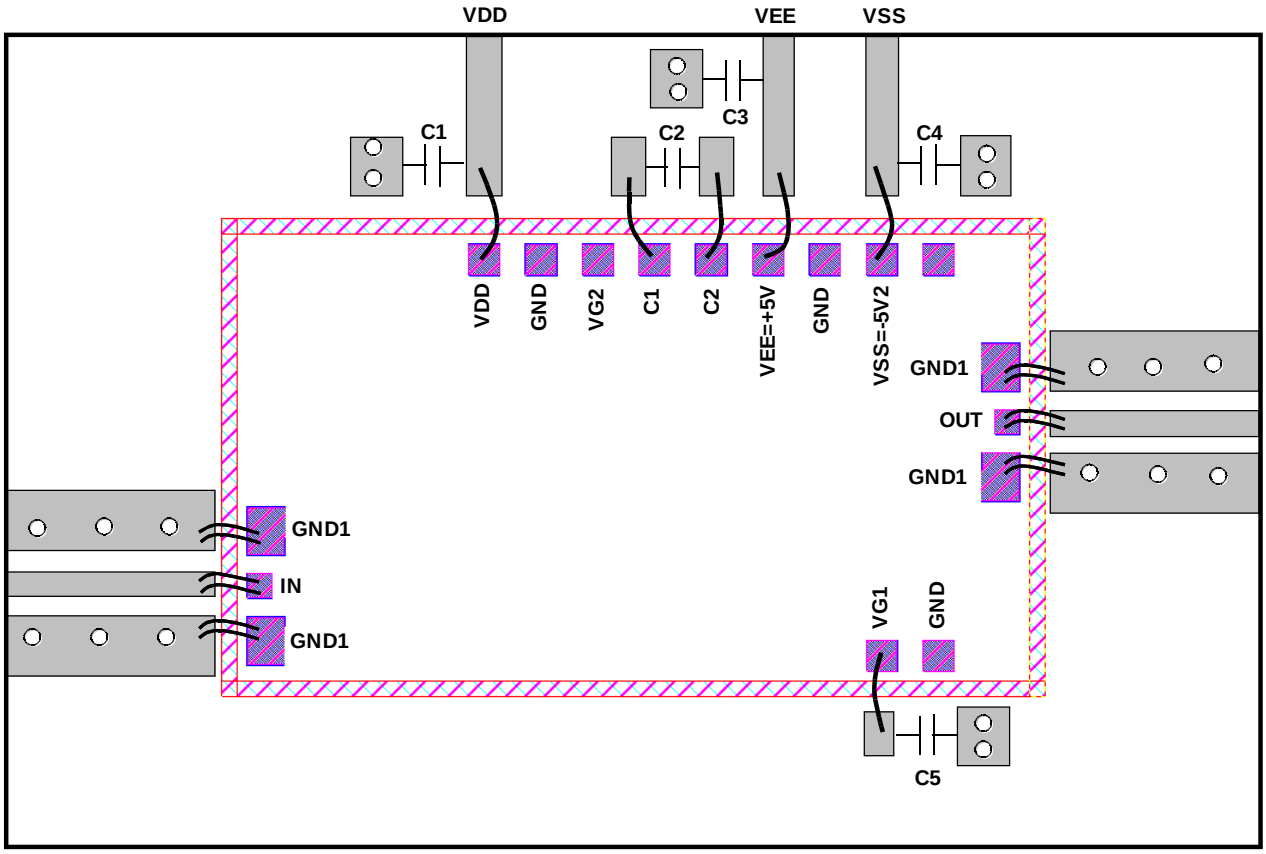
Frequency (GHz)	Mag S11	Ang S11 (°)	Mag S21	Ang S21 (°)	Mag S12	Ang S12 (°)	Mag (S22)	Ang S22 (°)
44	-12.73	107.4	14.3	-129.3	-28.18	-86.86	-20.48	-66.37
45	-9.244	77.42	13.69	-161.9	-28.85	-116.2	-19.8	-90.23
46	-9.312	51.15	12.72	166.1	-29.67	-144.3	-22.81	-102.2
47	-12.29	44.47	11.46	133.9	-30.08	-178.9	-25.43	-99.08
48	-11.21	70.94	9.539	104.2	-32.64	143	-30.22	-91.09
49	-7.33	64.73	7.635	79.35	-37.62	117.3	-31.3	-35.28
50	-5.894	55.11	6.036	60.29	-39.17	123.3	-24.35	-26.23
51	-4.385	47.77	5.797	42.49	-37.66	120.6	-21.37	-53.51
53	-2.464	25.52	6.207	-9.246	-32.72	83.6	-21.94	179.8
55	-1.974	7.453	5.82	-72.83	-30.28	31	-13.69	59.33
57	-1.705	-6.393	5.087	-138.4	-28.33	-39.33	-15.01	-4.052
58	-1.729	-12.98	4.586	-172.3	-27.65	-65.17	-22.14	16.58
59	-1.884	-18.35	3.668	153.1	-27.57	-97.43	-13.74	54.9
60	-1.942	-22.32	3.37	117.1	-27.34	-135.5	-9.119	26.9
61	-1.958	-25.48	2.964	76.03	-27.96	179.7	-8.565	-13.97
62	-1.684	-32.33	3.8	24.65	-26.48	128.4	-13.44	-122.8
63	-2.258	-37.93	-0.3021	-45.56	-27.99	49.22	-3.593	88.19
64	-2.491	-37.36	-6.14	-93.87	-34.85	-5.534	-1.471	37.22
65	-2.488	-39.02	-13.94	-129.3	-41.16	-24.08	-1.207	12.06

NOTE

The S-Parameter data presented is measured using high frequency RF probes. DC biasing is provided via DC biasing networks that include suitable decoupling capacitors.

APPLICATION INFORMATION

Typical application scheme



Chip assembly and Bonding diagram : with automatic current control via V_{EE} and V_{SS}.

RECOMMENDED COMPONENTS

Name	Value	Manufacturer part number
C1, C3, C4, C5	100 nF	0402 sub-mount capacitors
C2	47 pF	Chip capacitor from appropriated manufacturer

Wedge-Wedge or Ribbon bonding is highly recommended to maintain the shortest possible bond wires. Degradation of gain and matching will be seen if the RF input and output inductances are not minimized. All others bond wire connections should also be kept as short as possible.

All RF input and output bonding inductance should be minimized to give the best performance of the module assembly. Two gold wires are recommended with maximum separation between the wires. Overall wire length should be kept less than 0.4 mm to keep the total equivalent inductance to less than 0.2 nH.

This MMIC has via holes connecting the front side to the backside of the chip. A good RF grounding connection should be maintained between the backside of the chip and system ground. The chip should be attached to ground plane using either AuSn solder or conductive epoxy material.

Capacitors C1, C3, C4, C5 are used for power supply rejection. The C2 capacitor is used to improve the low frequency gain flatness. The gain has a typical low frequency cut-off of 500 MHz but the device is specified at 1.5 GHz due to the input return loss being higher than -10 dB at low frequencies.

Biasing Information

The nominal bias conditions is V_{DD} = +5.0 V, V_{EE} = +5.0 V, V_{SS} = -5.2 V. This is a good linear operating point. V_{EE} and V_{SS} are used for current control. Power supply sequence will be as follow : apply V_{SS} first, then V_{EE} and finally V_{DD}.

Other biasing points can be used depending on the application :

For application needing lower small signal amplification (gain control),V_{G2} can be set in the range of values specified in the DC characteristics table. V_{G2} will be applied after applying V_{DD}. The values of V_{SS} and V_{EE} are maintained at their typical values, -5.2 V and +5.0 V respectively.

DC blocks

The amplifier has on-chip MIM capacitors on the input and output RF lines which provide DC isolation. Therefore, external coupling capacitors are not required into the RF paths.

OPERATING AND HANDLING INSTRUCTIONS

The CGY2160UH/C1 is a very high performance GaAs 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

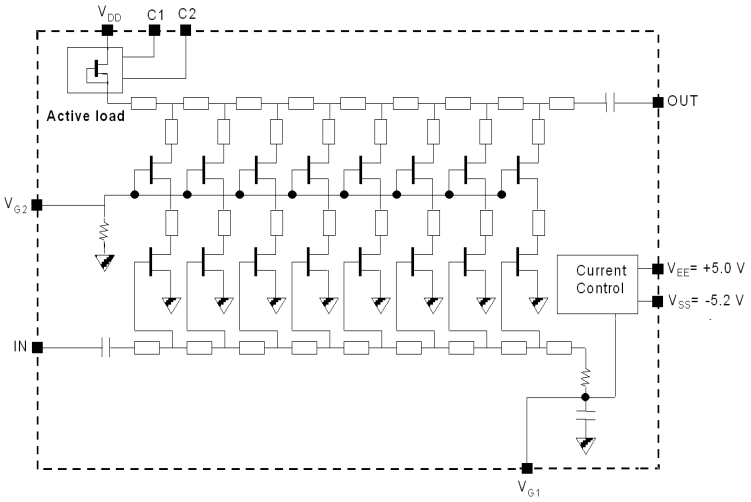
The following power supply sequence is recommended.

i) Apply V_{SS} and V_{EE}
ii) Apply V_{DD}
iii) Apply the RF input signal

2- Mounting and ESD handling precautions

For high performance Integrated Circuits, such as the CGY2160UH/C1, 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 III-V users".

BLOCK DIAGRAM AND PAD CONFIGURATION



Block Diagram of the CGY2160UH/C1

PAD POSITION

SYMBOL	PAD	Y	X	DESCRIPTION
GND1	1	2476	511	Ground
IN	2	2476	336	RF input
GND1	3	2476	161	Ground
V_{G1}	4	503	115	Must be decoupled to ground using an external capacitor (figure 5)
GND	5	323	115	Ground
GND1	6	104	683	Ground
OUT	7	104	858	RF output
GND1	8	104	1033	Ground
V_{SS}=-5V2	9	503	1375	DC supply voltage, used for current control, must be decoupled to ground using external capacitor (s)
GND	10	683	1375	Ground
V_{EE}=+5V	11	863	1375	DC supply voltage, used for current control, must be decoupled to ground using external capacitor (s)
C2	12	1043	1375	Used for connecting an external capacitor (figure 5)
C1	13	1223	1375	Used for connecting an external capacitor (figure 5)
V_{G2}	14	1403	1375	Do not bond
GND	15	1583	1375	Ground
V_{DD}	16	1763	1375	Drain supply voltage, must be decoupled to ground using an external capacitor (s)

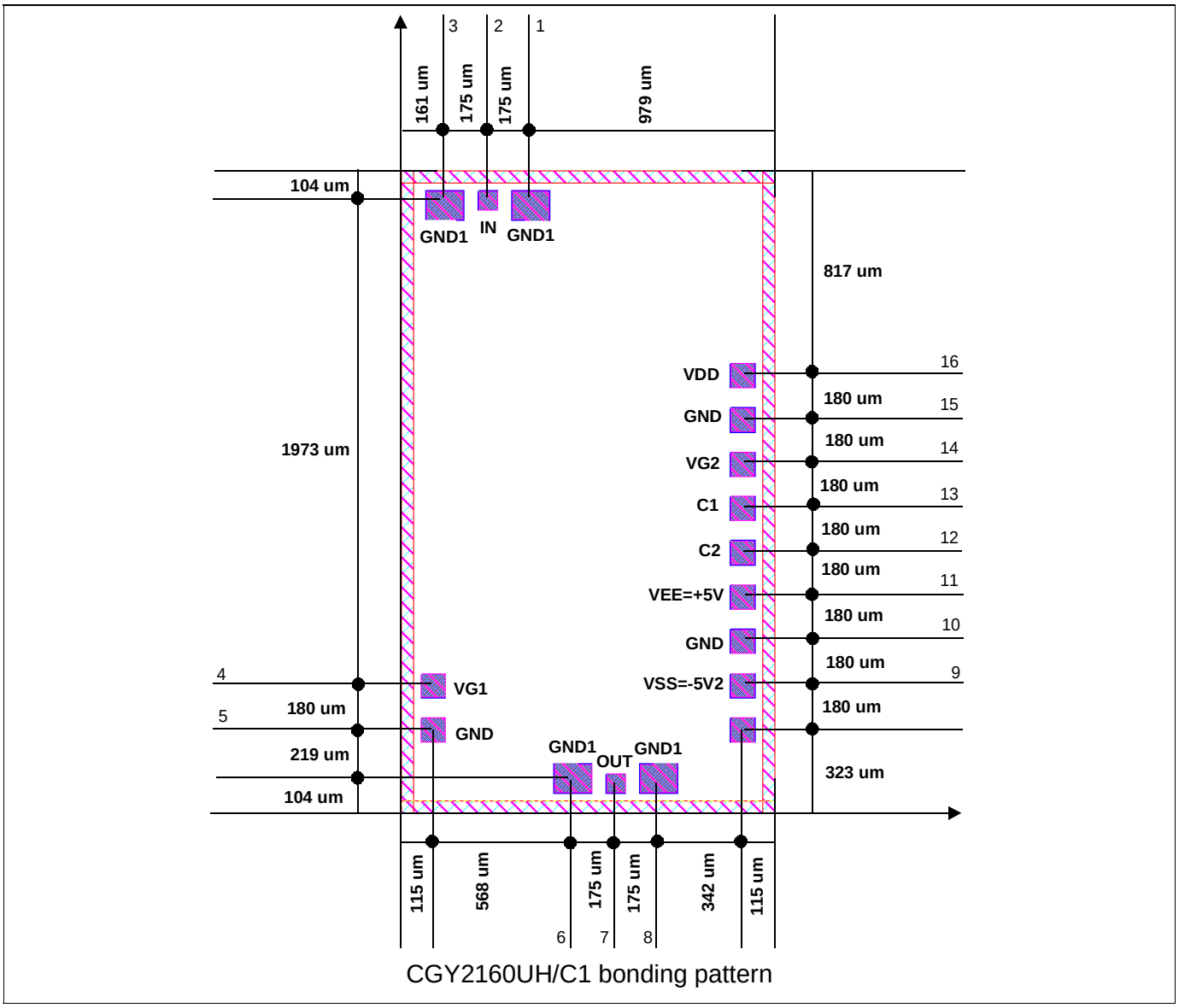
NOTE

1-All x and y coordinates in µm represent the position of the centre of the pad with respect to the lower left corner of the chip layout (see the bonding pattern).

MECHANICAL INFORMATION

PARAMETER		VALUE
Size		1490 x 2580 µm (Tolerance : +/- 15 µm)
Thickness		100 µm
Backside material		TiAu
Bonding pad dimensions	V_{DD}, GND, V_{G2}, C1, C2, V_{EE}, V_{SS}, V_{G1}	100 x 100 µm
	IN, OUT	79 x 79 µm
	GND1	154 x 120 µm

BONDING PADS



CGY2160UH/C1 bonding pattern

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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ORDERING INFORMATION

Generic type	Package type	Version	Description
CGY2160UH	Bare Die	C1	InGaAs Semi-conductor die. External dimensions : 1490 x 2580 µm (Tolerance : ±15 µm). Die thickness: 0.1 mm. Backside material: TiAu

RoHS Compliant

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