PRODUCT DATASHEET

CGY2102UH/C2

2.5 Gb/s TransImpedance Amplifier

DESCRIPTION

The CGY2102UH is a high performance 2.5 Gb/s TransImpedance Amplifier (TIA). Typical use is as a low noise preamplifier for lightwave receiver modules in optical fiber networks. The TIA gives an exceptionally good sensitivity and high gain.
The device is intended to be used with a PIN or APD photodetector. There is a built in AGC function which limits the peak-to-peak output voltage and protects the device from optical input overload.
The CGY2102UH/C2 can be assembled in a small form factor packages, such as TO-46 headers.
The die is manufactured using OMMIC's 0.18 µm gate length PHEMT Technology. The MMIC uses gold bonding pads and backside metallization and is fully protected with Silicon Nitride passivation to obtain the highest level of reliability. This technology has been evaluated for Space applications and is on the European Preferred Parts List of the European Space Agency.

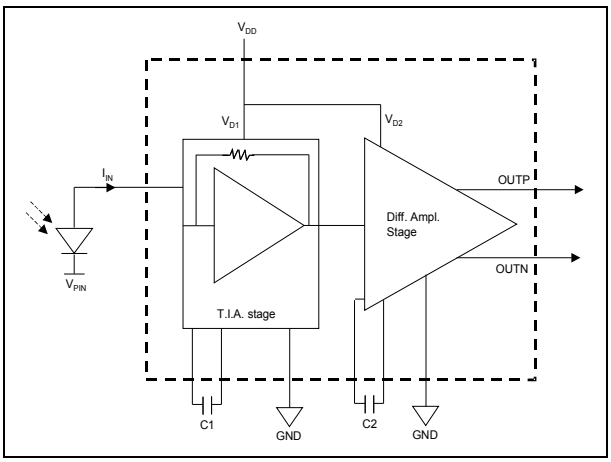
APPLICATIONS

- Digital optical STM-16 or OC-48 transmission systems
- PIN or APD preamplifier receivers
- GPON Optical Network Unit (ONU)

RoHS Compliant

FEATURES

- Suitable for 2.5 Gb/s optical fiber links
- Single +3.3 V to +5.0 V supply voltage
- 70 dBΩ differential transimpedance gain
- Sensitivity : -27.5 dBm @ BER of 10^{-10}
- Built in AGC function
- Differential output
- 2.5 mA peak-to-peak input overload current
- 45 mA consumption current at +3.3 V
- Tested, Inspected Known Good Die (KGD)
- Samples Available
- Demonstration Boards Available
- Space and MIL-STD Available



Block Diagram of the CGY2102UH/C2

Website : www.ommic.com

OMMIC
2, Chemin du Moulin – BP. 11
94 453 Limeil-Brévannes – FRANCE

Email : Information@ommic.com

LIMITING VALUES

T_{amb} = 25 °C unless otherwise noted

Symbol	Parameter	Conditions	MIN.	MAX.	UNIT
V_{DD}	Supply voltage		- 0.5	+ 8	V
I_{IN}	Input average photo-current	V_{DD} = 3.3 V		4.0	mA
T_{stg}	Storage temperature		- 55	+ 150	° C
T_{ch}	Maximum operating channel temperature			+ 150	° C

OPERATING CONDITIONS

Symbol	Parameter	Conditions	MIN.	TYP.	MAX.	UNIT
V_{DD}	Supply voltage (see note 1)		3.0	3.3	3.6	V
V_{DD}	Supply voltage (see note 1)		4.75	5.0	5.25	V
T_{op}	Operating ambient temperature		- 40		+ 100	°C
Input interface	DC coupled					
Output interface	AC coupled					

NOTE

1. The TIA IC operates properly in the entire range between 3.0 V and 5.25 V. Nevertheless, the circuit is specified at V_{DD} = 3.3 V ± 0.3 V and V_{DD} = 5.0 V ± 0.25 V.

DC CHARACTERISTICS

Minimum/Maximum values are defined at V_{DD} = 3.3 V ± 0.3 V, T_{amb} = -40°C to +100°C; Typical data is defined at T_{amb} = 25 °C, V_{DD} = 3.3 V ; unless otherwise noted.

Symbol	Parameter	Conditions	MIN.	TYP.	MAX.	UNIT
I_{DD}	Supply current			45	64	mA
V_{INDC}	DC input voltage (**IN** pad)			1.2	1.8	V
V_{OUTDC}	DC output voltage level			2.5		V
dV_{OUT}	Voltage offset between the two outputs		-0.7		+0.7	V

Symbol	Parameter	Conditions	MIN.	TYP.	MAX.	UNIT
I_{DD}	Supply current			60	88	mA
V_{INDC}	DC input voltage (**IN** pad)			1.3	1.8	V
V_{OUTDC}	DC output voltage level			4		V
dV_{OUT}	Voltage offset between the two outputs		-0.7		+0.7	V

AC CHARACTERISTICS

All measured data is at V_{DD} = 3.3 V; T_{amb} = 25 °C; R_L = 50 Ω. The TIA is measured on-wafer using RF probes. AC characteristics are guaranteed for both OUTP and OUTN ; Unless otherwise stated.

Photodiode elements and parasitics :

Symbol	Parameter	Conditions	MIN.	TYP.	MAX.	UNIT
C_{PH}	Photodiode capacitance	Suggested value		0.3		pF
L_{PH}	Photodiode bonding inductance	Suggested value		2.5		nH
R_{PH}	Photodiode series resistance	Suggested value		8.0		Ohms

Symbol	Parameter	Conditions	MIN.	TYP.	MAX.	UNIT
$\|ZT\|_{LF}$	Low-Frequency Transimpedance gain @ 200 MHz (see note 2) Single-ended		68.5	70		dBΩ
		V_{DD} = 3.3 V ± 0.3 V ; T_{amb} = -40°C to +100°C	68			dBΩ
		@ V_{DD} = 5 V, T_{amb} = +25°C		73		dBΩ
F_C	Transimpedance gain cut-off frequency $\|ZT\| = \|ZT\|_{LF} - 3$ dB		2.5	2.8		GHz
		V_{DD} = 3.3 V ± 0.3 V ; T_{amb} = -40°C to +100°C	2.2			GHz
		@ V_{DD} = 5 V, T_{amb} = +25°C		3.5		GHz
$F_{c,Low}$	Low Frequency cut-off (see note 3)	AC coupled at the outputs (via 100 nF capacitor)			25	KHz
$\Delta\|ZT\|$	Transimpedance ripple (= $\|ZT\| - \|ZT\|_{LF}$)	F = 0.1 MHz to 1 GHz	-1.0		+1.2	dBΩ
		F = 1 GHz to 1.8 GHz	-1.5		+1.5	dBΩ
		F = 1.8 GHz to Fc			+2.0	dBΩ
V_{OUT}	Output swing, single-ended			325		mVpp
I_{PKMAX}	Maximum peak input current before input overload		2.5			mApp
$\|S_{22}\|$	Output reflection coefficient. Input loading conditions : C_{PH} = 0.3 pF; L_{PH} = 2.5 nH; R_{PH} = 8 Ω	F = 0.1 GHz to 2.2 GHz			-12	dB
		F = 2.2 GHz to 3 GHz			-8	dB
I_{NOISE}	Total integrated input RMS noise	F = 0.1 GHz to 2.8 GHz		207		nA
S	Optical input sensitivity (note 4)	ρ = 0.9 A/W, r_e = 10 dB, BER = 10^{-10}		-27.5		dBm
R_L	Output load termination (OUTN, OUTP)			50		Ω

NOTE

2. The gain specification is guaranteed down to the lower cut-off frequency. 0.2 GHz is specified as a reference for convenience of measurement.

3. The CGY2102UH is AC coupled at its outputs via an external capacitors, C3 and C4. Hence the low frequency cut-off is determined by the time constant RC, where R is the total output resistance (on-chip output series 50 Ohms impedance of the TIA circuit plus the external 50 Ohms load) equivalent to 100 Ohms. Assuming that C3 = C4 = 100 nF, the low frequency cut-off is given by : F_{c_low} = 1/(2 x pi x R x C3) = 16 KHz.

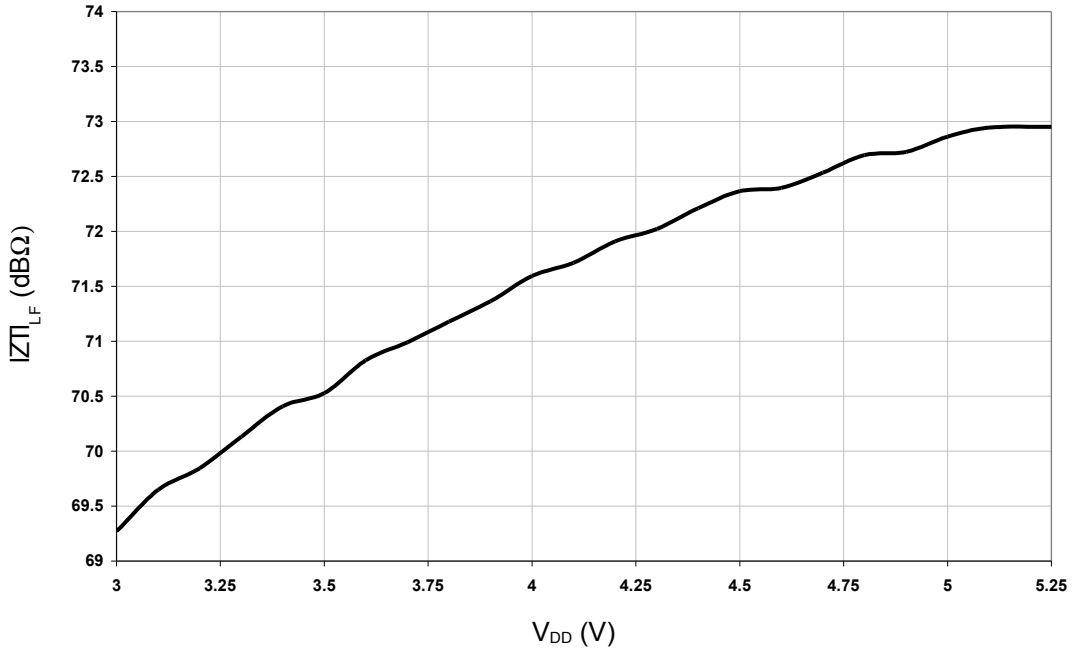
4. The sensitivity is computed from the total integrated input RMS noise. To obtain a system bit-error rate of 10^{-10}, the signal-to-noise ratio must be 12.7 or better. The input sensitivity, expressed in average power, is calculated as :

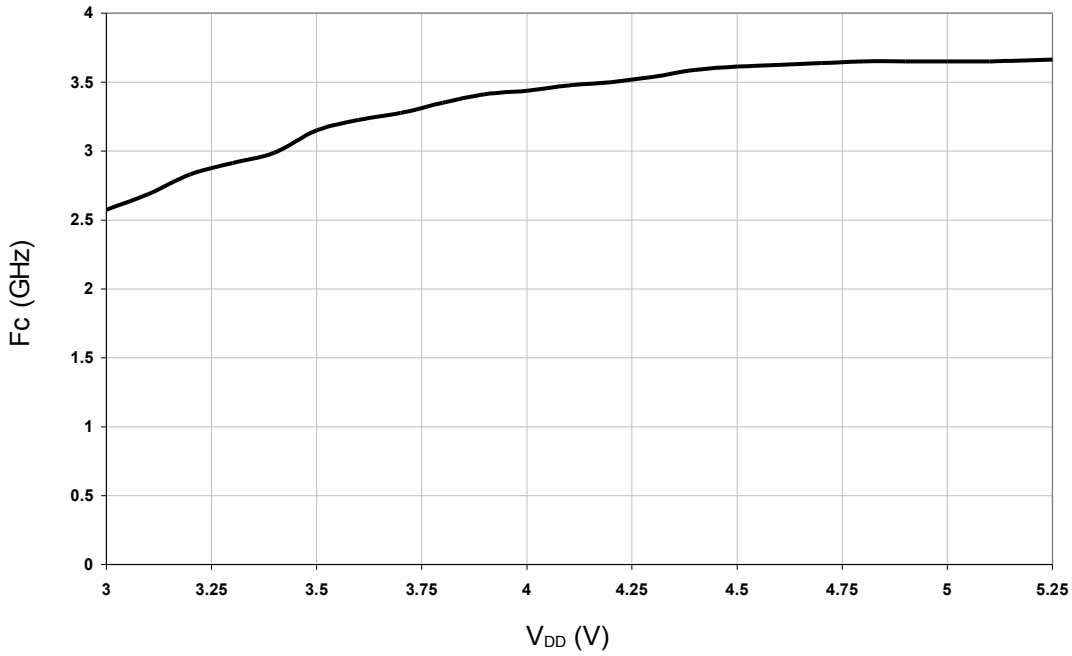
$$\text{Sensitivity} = 10 \times \log\left(\frac{12.7 \times I_{NOISE} \times (r_e + 1)}{2 \times \rho \times (r_e - 1)} \times 1000\right) \text{(dBm)}$$

where ρ and r_e are respectively, the photodiode responsivity in A/W and the extinction ratio. I_{NOISE} is measured in amperes.

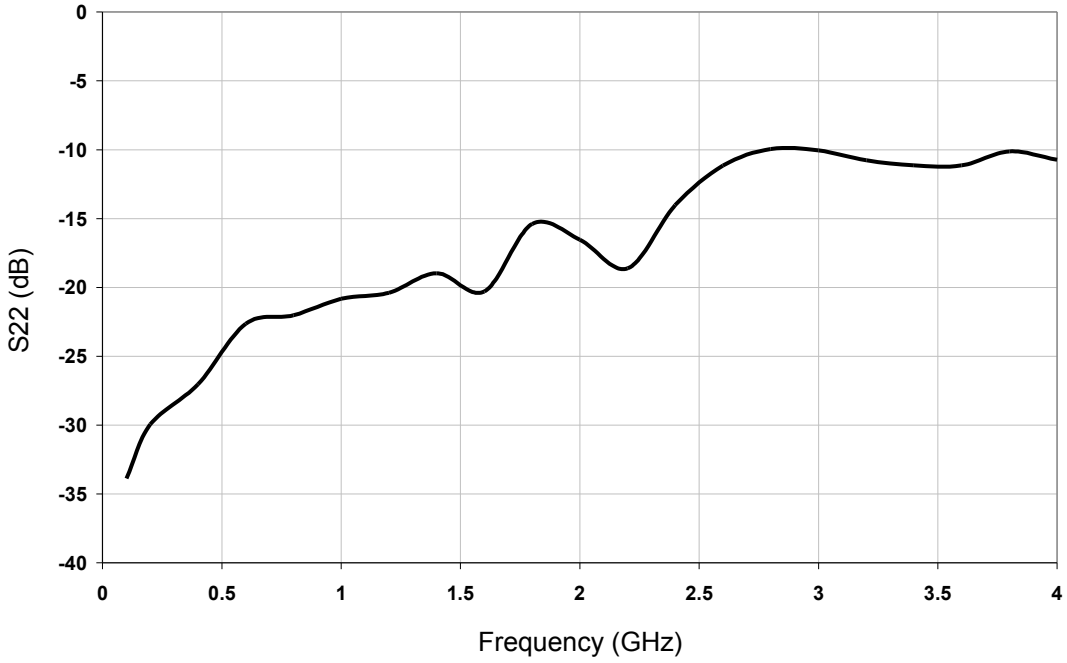
MEASURED PERFORMANCE CHARACTERISTICS

Operating Temperature of 25°C. Results are from on-wafer measurements.

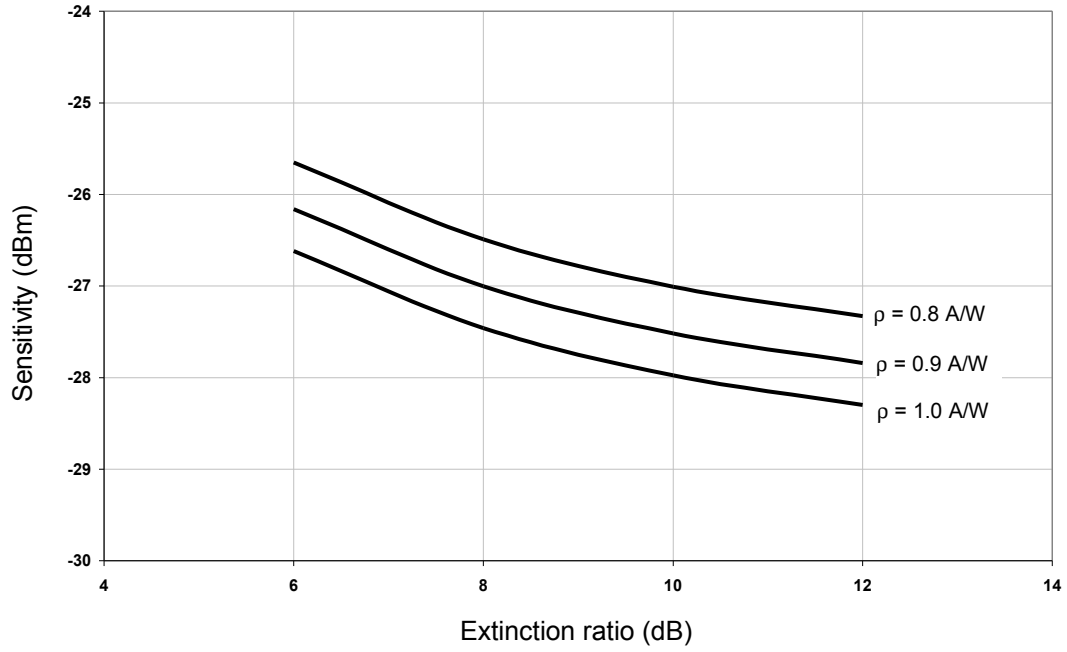




Transimpedance gain vs. V_{DD} and High frequency cut-off vs. V_{DD}.
Photodiode elements : Cph = 0.3 pF, Lph = 2.5 pH, Rph = 8 Ω.

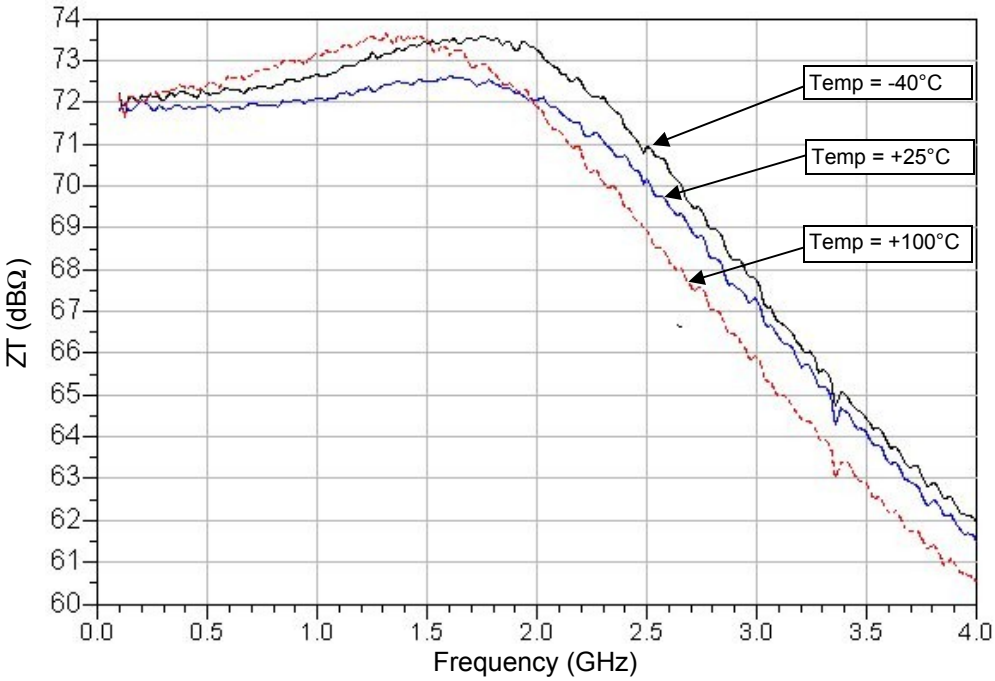


Output reflection coefficient vs. Frequency (V_{DD} = 3.3V)
Photodiode elements : Cph = 0.3 pF, Lph = 2.5 nH, Rph = 8 Ω.



Sensitivity vs. Extinction ratio at various photodiode sensitivity, ρ.

Operating Temperature of - 40°C and +100°C. Results are from evaluation board.



Transimpedance gain at various operating temperature (V_{DD} = 3.3 V)

APPLICATION INFORMATION

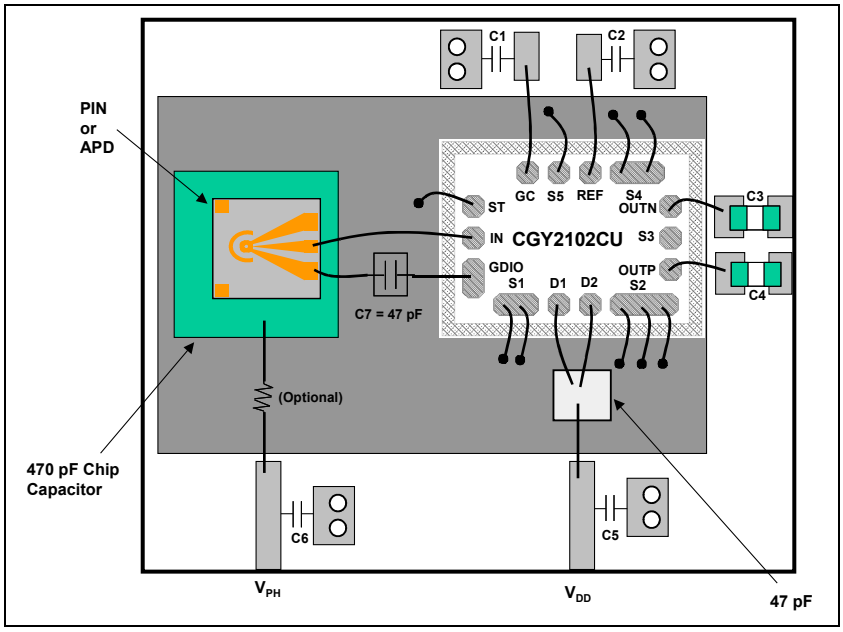
The performance of the photo-receiver module is very dependent on the photodiode capacitance of the photodiode. The circuit was optimized for a photodiode capacitance C_{PH} lower than 0.3 pF with a low photodiode series resistance (R_{PH}) to give the best noise performance from the receiver module.

The CGY2102UH can be used in differential or single ended topology. In the case of single ended configuration, the unused output pad is connected to a 50Ω load via a DC blocking capacitor (C3, C4).

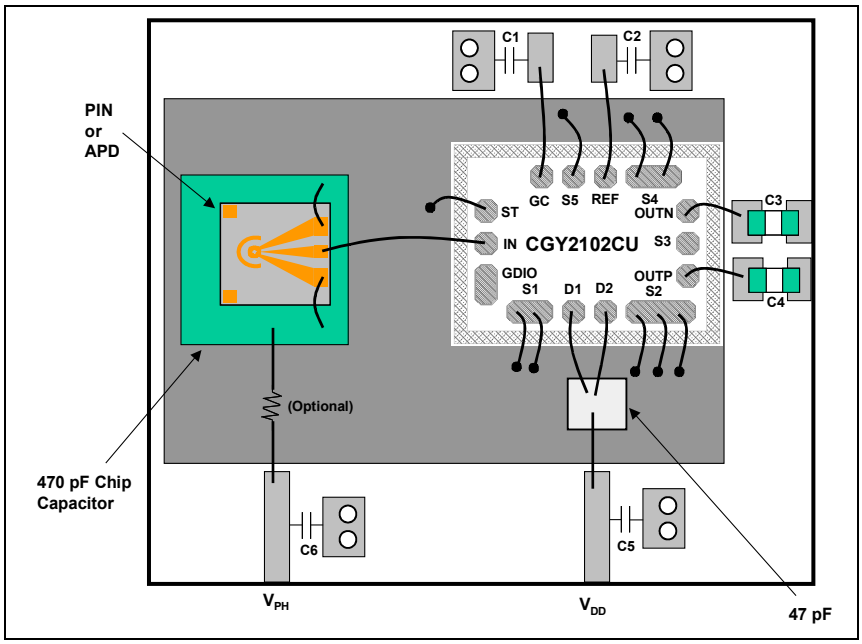
1) Recommended Assembly for RF Performances Guarantee

Two module layout are proposed. The difference occurs only at the input of the receiver :

- In configuration 1, the photodiode cathode is connected to GDIO pad chip via C7 = 47 pF capacitor. This configuration offers slightly more bandwidth.
- The second configuration is more compact at the input.



Configuration 1 : Chip assembly and bonding diagram



Configuration 2 : Chip assembly and bonding diagram

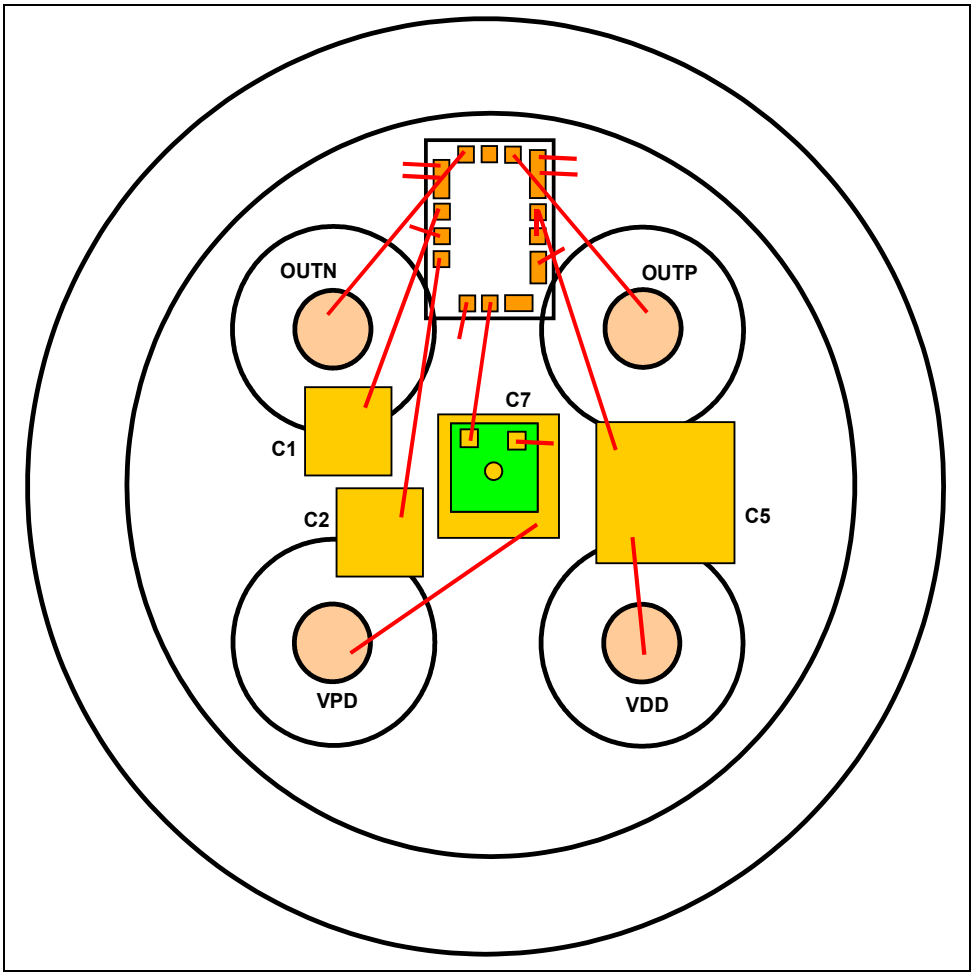
Recommended components :

Name	Value	Manufacturer part number
C1, C2, C5, C6	10 nF	-
C3, C4	100 nF	-

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.

2) Suggested Assembly in a 5-pin TO-46

Typical application inside a 5-pin TO-46 is in the figure below. Output RF coupling capacitors, at ports OUTP and OUTN, are implemented outside the TO-46. Therefore, they do not appear in this figure.



Chip assembly and bonding diagram for a 5-Pin TO-46

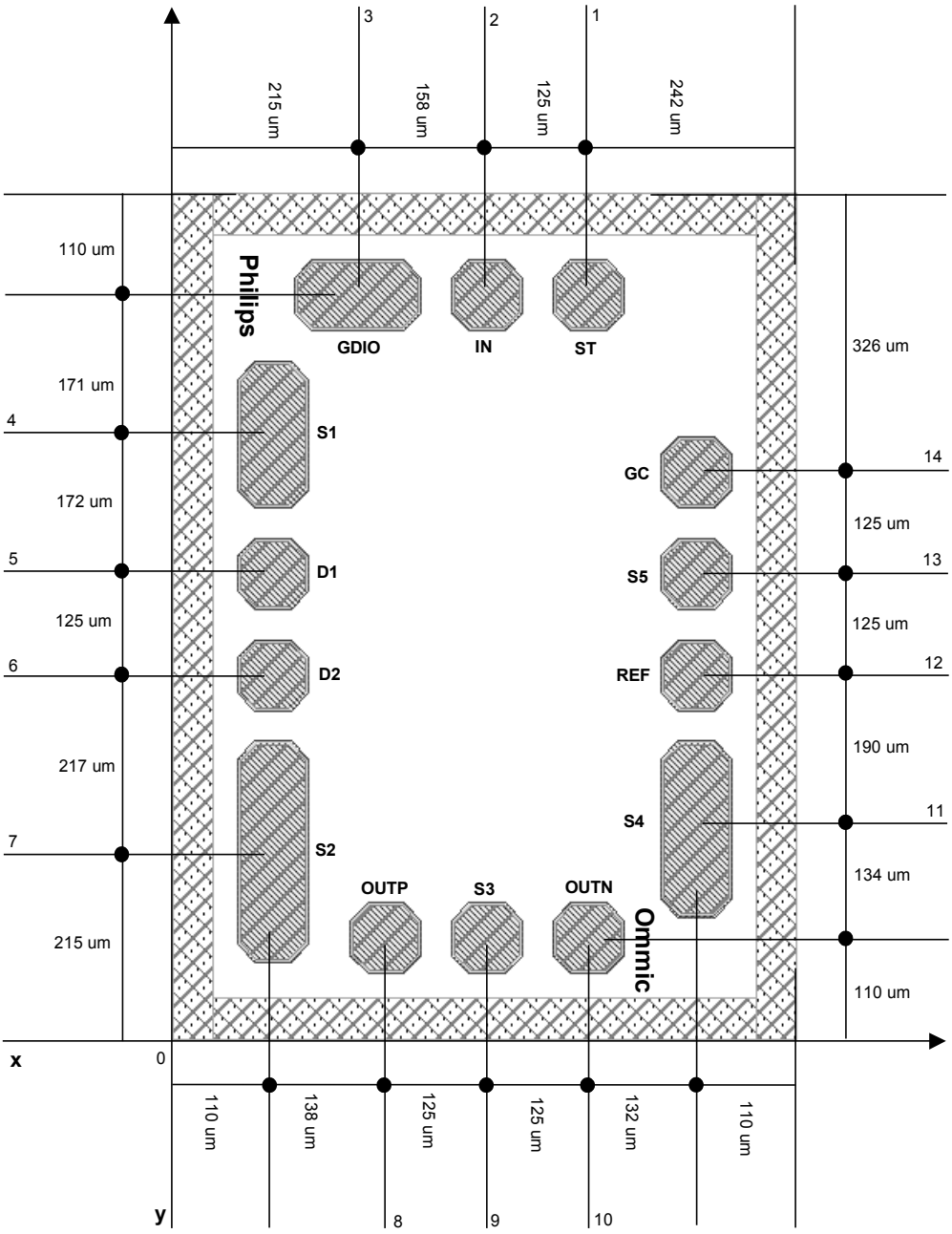
Recommended components

Name	Value	Manufacturer part number
C1, C2	1.5 nF	-
C5	10 nF	-
C7	0.5 nF	-

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

MECHANICAL INFORMATION

Chip size = 1010 x 740 µm (± 15 µm)
Chip Thickness = 200 µm



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PAD POSITION

PAD NAME	PAD NUMBER	COORDINATES		DESCRIPTION
		X	Y	
ST	1	900	498	Bond to ground
IN	2	900	373	RF Input. To be connected to photodiode anode
GDIO	3	900	215	Configuration 1 : connected to photodiode cathode via external capacitor. Configuration 2 : Do not bond
S1	4	729	110	Bond to ground
D1	5	557	110	First stage DC supply voltage, must be decoupled to ground using external capacitor(s)
D2	6	432	110	Second stage DC supply voltage, must be decoupled to ground using external capacitor(s)
S2	7	215	110	Bond to ground
OUTP	8	110	248	RF positive non inverting data output
S3	9	110	373	Bond to ground
OUTN	10	110	498	RF negative inverting data output
S4	11	244	630	Bond to ground
REF	12	434	630	Reference input voltage, must be decoupled to ground using an external capacitor
S5	13	559	630	Bond to ground
GC	14	684	630	Gain control pad, must be decoupled to ground using an external capacitor

All x and y coordinates (in µm) represent the position of the center of the pad with respect to the lower left corner of the chip layout
See Mechanical Information for more details.

Bonding Pad	Dimensions (µm)
ST, IN, D1, D2, OUTP, S3, OUTN, REF, S5, GC	90 x 90 µm
GDIO	157 x 90 µm
S1	180 x 90 µm
S2	272 x 90 µm
S4	216 x 90 µm

PACKAGE

Type	Description	Terminals	Pitch (mm)	Die size (mm)
UH	Bare Die	-	-	1.01 x 0.74 mm ±15 µm Die Thickness : 200 µm

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
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ORDERING INFORMATION

Generic type	Package type	Version	Sort type	Description
CGY2102	UH	C2	-	2.5 Gb/s TransImpedance Amplifier

RoHS Compliant

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