3-Port, 6-Bits, C-Band Integrated Core Chip 4.5 - 6.5 GHz



CGY2175AUH/C1 Rev. V1

Features

Insertion Loss: 12 dB @ 5.4 GHz

Phase Shift Range: 360°
Attenuation Range: 31.5 dB

RMS Phase Error: 1.3° @ 5.4 GHz

RMS Amplitude Error: 0.2 dB @ 5.4 GHz

 Amplitude Error: 0.2 dB @ 5.4 GHz

• Return Loss: <-14 dB @ 5.4 GHz (All States)

Total Power Consumption: 0.1 W
Chip Size: 3765 x 4465 µm ±5 µm

Tested, Inspected Known Good Die (KGD)

Samples Available

Demonstration Boards Available

Space & MIL-STD Available

RoHS* Compliant

Applications

- Radar
- Telecommunication
- Instrumentation

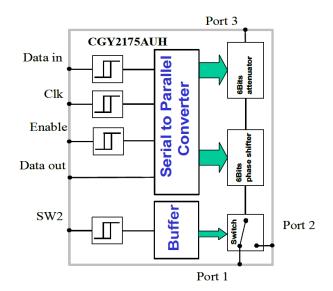
Description

The CGY2175AUH/C1 is a high performance GaAs pHEMT technology MMIC 3 port, 6—bit Core Chip operating in C-band. It includes a 6-bit phase shifter, a 6-bit attenuator and T/R switch. The on-chip series to parallel converter minimizes the number of bonding pads and greatly simplifies the use of the Core Chip functions.

The die is manufactured using 0.18 µm gate length pHEMT Technology. The MMIC uses gold bond 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.

Block Diagram



Ordering Information

Part Number	Package
CGY2175AUH/C1	Die

^{*} Restrictions on Hazardous Substances, compliant to current RoHS EU directive.

3-Port, 6-Bits, C-Band Integrated Core Chip 4.5 - 6.5 GHz



CGY2175AUH/C1

Electrical Specifications: Freq. = 5.4 GHz, $T_A = +25^{\circ}\text{C}$

Parameter	Test Conditions	Units	Min.	Тур.	Max.
Supply Voltage	Positive Negative Digital Negative	V	+4.5 -3.25 -3.25	+5.0 -3.00 -3.00	+5.5 -2.75 -2.75
Supply Current	Positive Negative Digital Negative	mA	_	9 10 9	
Insertion Loss	No Attenuation	dB	_	11.7	_
Input Return Loss	Port 1 & Port 2	dB	_	-14	_
Output Return Loss	Port 3	dB	_	-14	_
Attenuation	Port 3 to Port 1 Port 3 to Port 2	dB	_	11.7 11.7	_
Switch Isolation	Port 2 to Port 1	dB	-40	_	_
Attenuation Range	_	dB	_	31.5	
RMS Attenuation Error ^{1,2}	_	dB	_	0.18	
Attenuation Variation	_	dB	-0.2	_	+0.7
Phase Range	_	٥	_	360	_
RMS Phase Error ^{1,2}	_	٥	_	1.25	4
Phase Variation	_	٥	-3	_	+3
P1dB	No Attenuation	dBm	_	20	_
Switching Time	Rx/Tx	ns	_	10	_
Serial Data Rate	_	MHz		100	_

^{1.} The RMS value is the root mean square of the error defined as below:

$$x_{\text{rms}} = \sqrt{\frac{1}{N} \sum_{i=1}^{N} x_i^2} = \sqrt{\frac{x_1^2 + x_2^2 + \dots + x_N^2}{N}}$$

^{2.} Where \boldsymbol{x}_i is the difference between the measured value and the expected value.



CGY2175AUH/C1

Rev. V1

Absolute Maximum Ratings^{3,4}

Parameter	Absolute Maximum		
Supply Voltage Positive Negative Digital Negative	-5 to +7 V -5 to +5 V -5 to +5 V		
Digital Data Input	-5 to +7 V		
Input Power @ RF Port 1 & Port 2	25 dBm		
Junction Temperature	+150°C		
Operating Temperature	-40°C to +85°C		
Storage Temperature	-55°C to +150°C		

^{3.} Exceeding any one or combination of these limits may cause permanent damage to this device.

Handling Procedures

Please observe the following precautions to avoid damage:

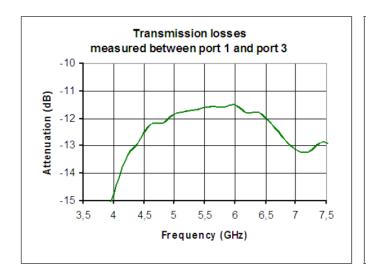
Static Sensitivity

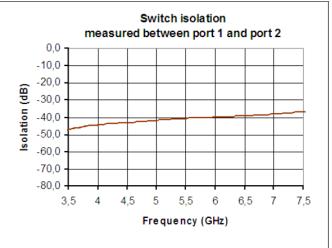
These electronic devices are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

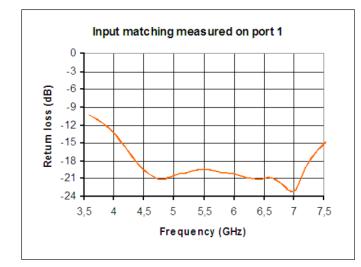
MACOM does not recommend sustained operation near these survivability limits.



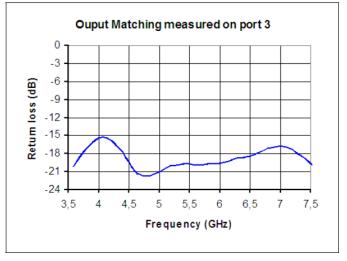
Typical Performance Curves: Measured on Reference State @ T_A = 25°C; V_{DD} = 5 V; V_{CC1} = V_{CC2} = -3 V; SW2 = +5 V





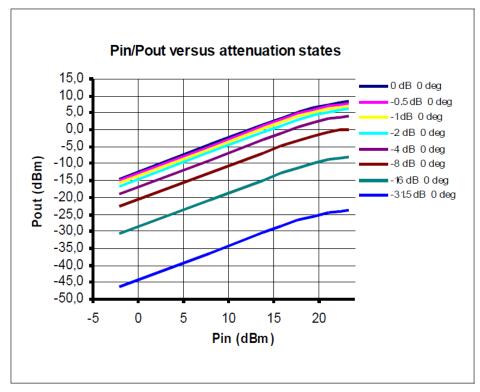


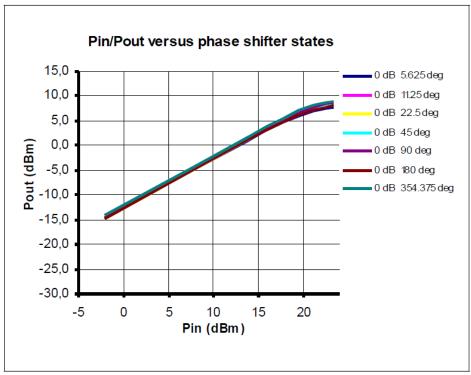
For further information and support please visit: https://www.macom.com/support





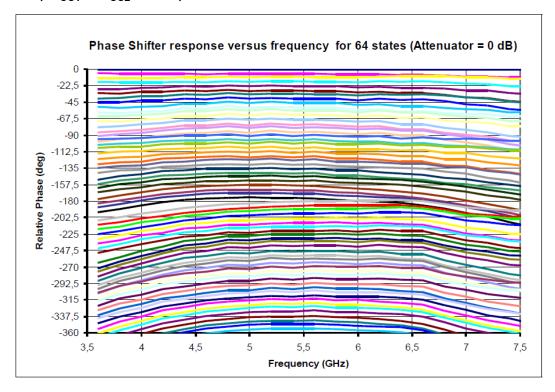
Typical Performance Curves: Measured on Reference State @ T_A = 25°C; V_{DD} = 5 V; V_{CC1} = V_{CC2} = -3 V; SW2 = +5 V

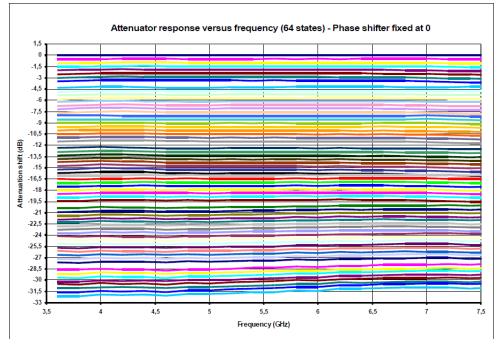






Typical Performance Curves: Measured on Reference State @ T_A = 25°C; V_{DD} = 5 V; V_{CC1} = V_{CC2} = -3 V; SW2 = +5 V

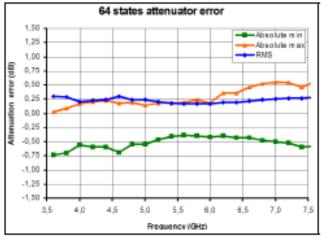


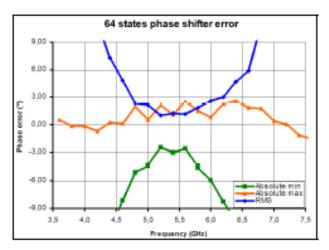


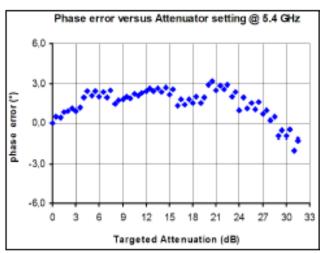
For further information and support please visit: https://www.macom.com/support

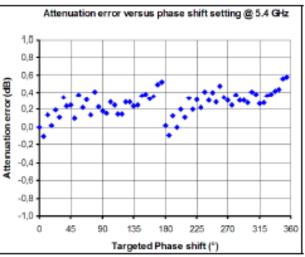


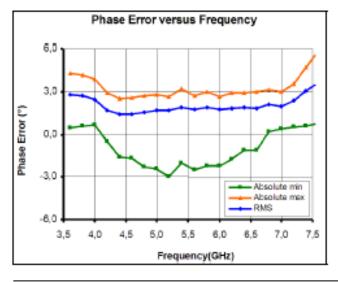
Typical Performance Curves: Measured on Reference State @ T_A = 25°C; V_{DD} = 5 V; V_{CC1} = V_{CC2} = -3 V; SW2 = +5 V

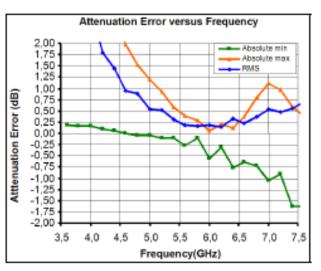






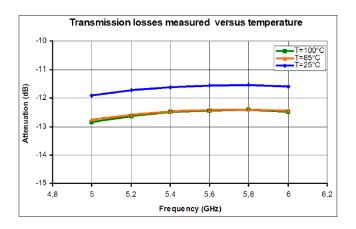


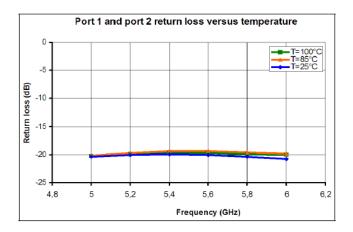


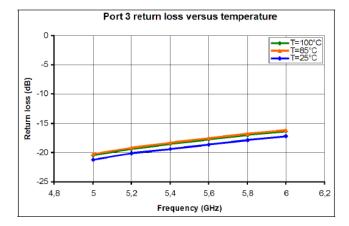




Typical Performance Curves: Measured on Reference State @ $T_A = 25$ °C;









Logic Truth Table (B0 is loaded first, and B11 last, see timing diagram)

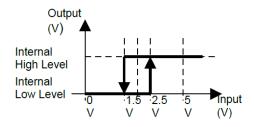
Bit #	Description	Reference State	Value
B0 (LSB ph)	Phase Shifter B0	High	5.625°
B1	Phase Shifter B1	High	11.25°
B2	Phase Shifter B2	High	22.5°
B3	Phase Shifter B3	High	45°
B4	Phase Shifter B4	High	90°
B5	Phase Shifter B5	High	180°
B6 (LSB att)	Attenuator B0	High	0.5 dB
B7	Attenuator B1	High	1 dB
B8	Attenuator B2	High	2 dB
В9	Attenuator B3	High	4 dB
B10	Attenuator B4	High	8 dB
B11	Attenuator B5	High	16 dB
CLK	Clock	_	_
LE	Latch Enable	_	_
SW1	Not Used	Connected to Ground	_
SW2	Port 1 to Port 2 Switch	High	RF Path between Port 1 & Port 3 Port 2 isolated & loaded by 50 Ω
	1 OIL 1 TO 1 OIL 2 OWITCH	Low	RF Path between Port 2 & Port 3 Port 1 isolated & loaded by 50 Ω

Control Logic (CMOS Standard Logic)

State	Min.	Max.
Low	0 V	0.2 V x V _{DD}
High	0.5 V x V _{DD}	V_{DD}

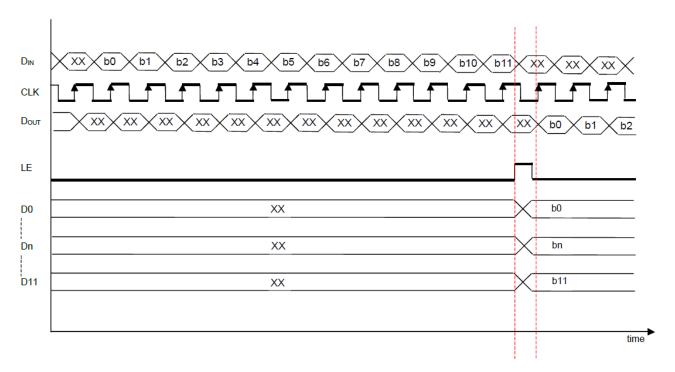
Input Schmidt Trigger

All inputs (DATA (DIN), Clock (CLK), Latch Enable (LE) and Switch Control (SW2)) include Schmidt triggers allowing an optimal data transfer to the CGY2175AUH even in a noisy environment and/or high speed data stream.





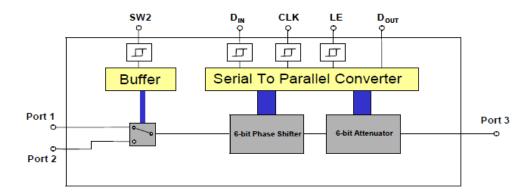
Timing Diagram



- DATA (DIN) is sampled at the rising edge of the Clock (CLK).
- Latch Enable (LE) must occur after all the 12 bits are loaded (i.e. after the rising edge associated with the bit b11) but before the subsequent rising edge of the Clock.
- The transferred data (DOUT) is available on the rising edge of the Clock following the Latch enable.

D_{IN} is the serial word containing 12 bits of information b0 to b11. Bits D0 to D11 are the internal parallel data used for the digital attenuator and digital phase shifter settings and is formed from the serial word b0 to b11.





Block Diagram of the CGY2175AUH fully Integrated C-band 3-port T/R chip

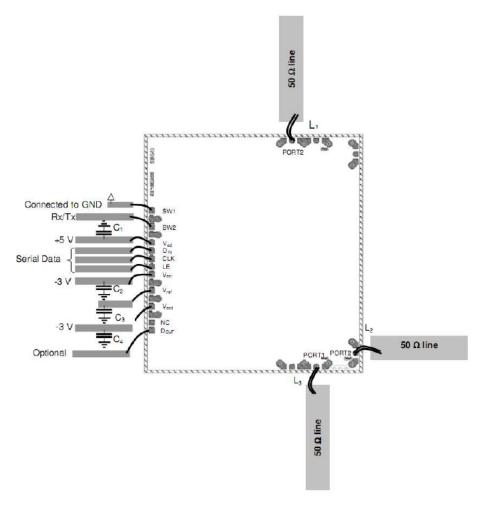
Pad Position⁵

Pad Nama	Pad Name Coordinate X Y		Description	
Pau Name				
SW1	80	3000	Not used – Must be connected to ground	
SW2	80	2700	Tx/Rx mode switch command	
DATA (DIN)	80	2250	Serial data input	
CLK	80	2100	Clock for serial to parallel converter	
LE	80	1950	Latch Enable command to load the data	
DOUT	80	750	Serial to parallel converter output for testing or to chain several chips	
Vdd	80	2400	Schmidt trigger positive supply voltage (+5 V)	
Vcc1	80	1800	Schmidt trigger negative supply voltage (-3 V)	
Vcc2	80	1200	Serial to parallel converter negative supply voltage (-3 V)	
Vref	80	1500	Internal voltage supply for Converter – Must be decoupled using 100 nF Nominal value = -2 V	
Port 1	2945	70	RF Input/Output	
Port 2	3625	326	RF Input/Output	
Port 3	2520	4325	RF Input/Output	

^{5.} X = 0, Y = 0 at bottom left corner.



Bonding Diagram & Assembly Information



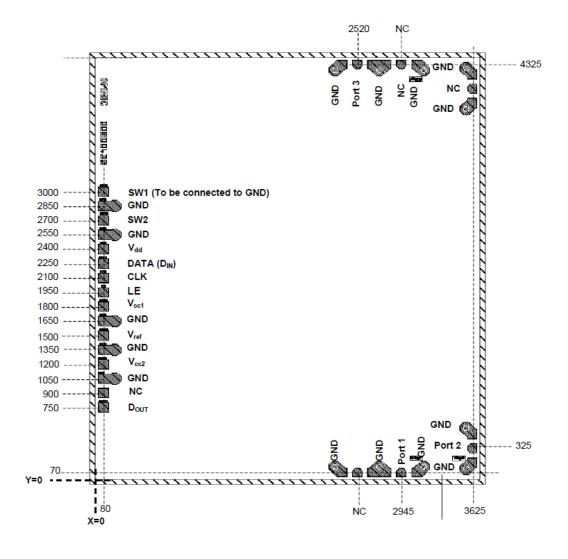
The number of wire bonds to the RF pads (L1, L2, L3) may be doubled to reduce the equivalent inductance. The optimal inductance is 0.35 nH in order to achieve the best return loss in the 5-6 GHz frequency band.

C1, C2, C3, C4 are 100 nF decoupling capacitors.

The pad « SW1 » is not used and should be connected to ground.



Mechanical Information



Chip Size = 3765 x 4465 μ m (before wafer sawing) DC Pads = 100 x 140 μ m, spacing = 150 μ m, top metal = Au RF Pads = 100 x 100 μ m, pitch = 150 μ m, top metal = Au Chip Thickness = 100 μ m Backside Metal = TiAu

3-Port, 6-Bits, C-Band Integrated Core Chip 4.5 - 6.5 GHz



CGY2175AUH/C1

Rev. V1

MACOM Technology Solutions Inc. ("MACOM"). All rights reserved.

These materials are provided in connection with MACOM's products as a service to its customers and may be used for informational purposes only. Except as provided in its Terms and Conditions of Sale or any separate agreement, MACOM assumes no liability or responsibility whatsoever, including for (i) errors or omissions in these materials; (ii) failure to update these materials; or (iii) conflicts or incompatibilities arising from future changes to specifications and product descriptions, which MACOM may make at any time, without notice. These materials grant no license, express or implied, to any intellectual property rights.

THESE MATERIALS ARE PROVIDED "AS IS" WITH NO WARRANTY OR LIABILITY, EXPRESS OR IMPLIED, RELATING TO SALE AND/OR USE OF MACOM PRODUCTS INCLUDING FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHT, ACCURACY OR COMPLETENESS, OR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHICH MAY RESULT FROM USE OF THESE MATERIALS.

MACOM products are not intended for use in medical, lifesaving or life sustaining applications. MACOM customers using or selling MACOM products for use in such applications do so at their own risk and agree to fully indemnify MACOM for any damages resulting from such improper use or sale.