

Attenuator, 6-Bit 1 - 15 GHz



CGY2171XBUH/C1

Rev. V1

Features

- Insertion Loss: 5 dB @ 10 GHz
- Attenuation Range: 31.5 dB
- RMS Attenuation Error: 0.25 dB @ 10 GHz
- Input P1dB: 20 dBm
- Return Loss: < -13 dB @ 10 GHz (All States)
- 0 / 5 V Control Lines
- Chip size = 2600 x 1200 $\mu\text{m} \pm 5 \mu\text{m}$
- Tested, Inspected Known Good Die (KGD)
- Samples Available
- Space and MIL-STD Available
- RoHS* Compliant

Applications

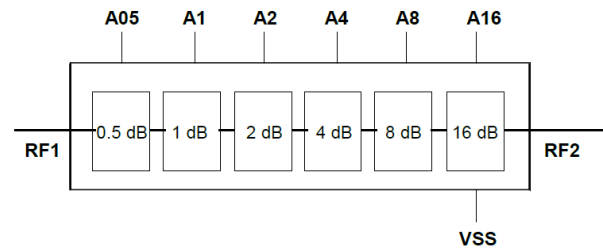
- Radar
- Telecommunication
- Instrumentation

Description

The CGY2171XBUH/C1 is a high performance GaAs MMIC 6-bit Attenuator operating in L, S, C, and X-band. This device has a nominal attenuation range of 31.5 dB in 0.5 dB steps. It covers the frequency range of 1 to 15 GHz and can be used in Radar, Telecommunication, & Instrumentation applications.

The die is manufactured using a 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.

Block Diagram



Pad Configuration^{1,2}

Pad	Function
RF1	RF Port 1
A05	0.5 dB cell control
A1	1 dB cell control
A2	2 dB cell control
A4	4 dB cell control
A8	8 dB cell control
A16	16 dB cell control
RF2	RF Port 2
VSS	Negative Supply Voltage
GND	Ground (back side)

1. MACOM recommends connecting No Connection (N/C) pins to ground.
2. The exposed pad centered on the package bottom must be connected to RF, DC and thermal ground.

Ordering Information

Part Number	Package
CGY2171XBUH/C1	Die

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

Attenuator, 6-Bit 1 - 15 GHz



CGY2171XBUEH/C1

Rev. V1

Electrical Specifications: Measured On Wafer Freq. = 10 GHz, V_{SS} = -5 V, I_{SS} = 8 mA, T_A = +25°C

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss	—	dB	—	5	—
Noise Figure	@ Reference State	dB	—	5	—
Attenuation Range	—	dB	—	31.5	—
Return Loss	@ RF1 & RF2	dB	—	15	—
RMS Attenuation Error ³	—	dB	—	0.25	—
Maximum RMS Attenuation Error ³	—	dB	—	±1	—
RMS Phase Error ³	—	°	—	5	—
Maximum RMS Phase Error ³	—	°	—	±8	—
P1dB	—	dBm	—	20	—

3. The RMS value is the root mean square of the error defined as below:
Where x_i is the difference between the measured value and the expected value.

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

Absolute Maximum Ratings^{4,5}

Parameter	Absolute Maximum
Attenuation Control Inputs	0 V to +7 V
Source Supply Voltage	-7 V to 0 V
Input Power	TBD
Junction Temperature	+150°C
Operating Temperature	-40°C to +85°C
Storage Temperature	-55°C to +150°C

4. Exceeding any one or combination of these limits may cause permanent damage to this device.
5. MACOM does not recommend sustained operation near these survivability limits.

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.

Logic Truth Table

	A05	A1	A2	A4	A8	A16
Nominal Attenuation	0.5 dB	1 dB	2 dB	4 dB	8 dB	16 dB
Pad	A05	A1	A2	A4	A8	A16
Attenuation Activated	5 V	5 V	5 V	5 V	5 V	5 V
Reference State	0 V	0 V	0 V	0 V	0 V	0 V

Logic Truth Table (Detailed)

	A05	A1	A2	A4	A8	A16
Attenuation (dB)	0.5	1	2	4	8	16
0	0	0	0	0	0	0
0.5	1	0	0	0	0	0
1	0	1	0	0	0	0
2	0	0	1	0	0	0
3	0	1	1	0	0	0
4	0	0	0	1	0	0
5	0	1	0	1	0	0
6	0	0	1	1	0	0
8	0	0	0	0	1	0
10	0	0	1	0	1	0
15	0	1	1	1	1	0
16	0	0	0	0	0	1
20	0	0	0	1	0	1
25	0	1	0	0	1	1
30	0	0	1	1	1	1
31.5	1	1	1	1	1	1

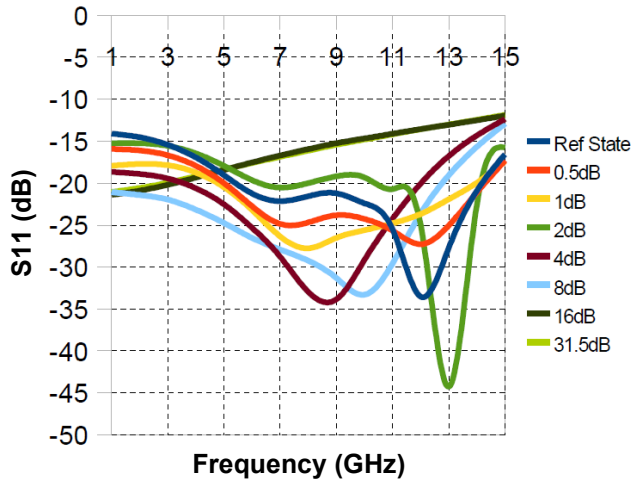
Control Voltage

State	Min.	Typ.	Max.	Unit
Low	-0.1	—	+0.1	V
High	4.75	5.00	5.25	V

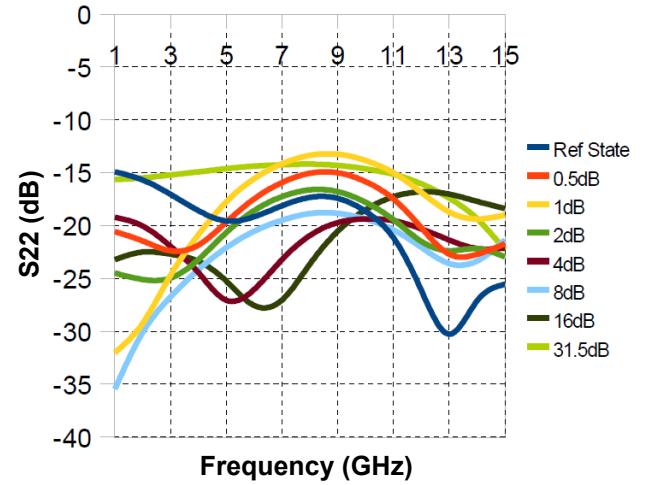
Typical Performance Curves: S-Parameters

On Wafer Measurements, calculated with input and output inductance of 0.3 nH

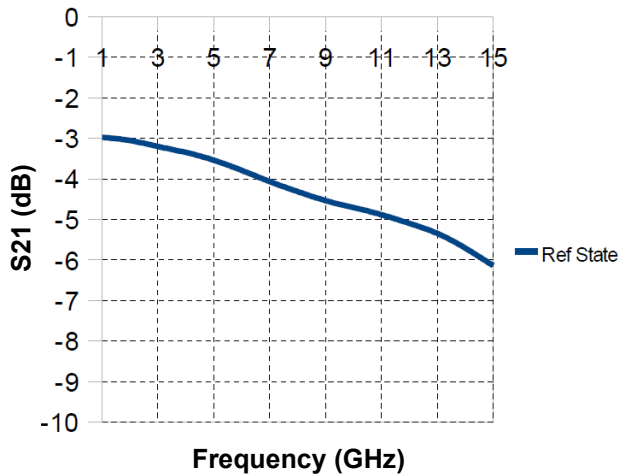
Input Return Loss



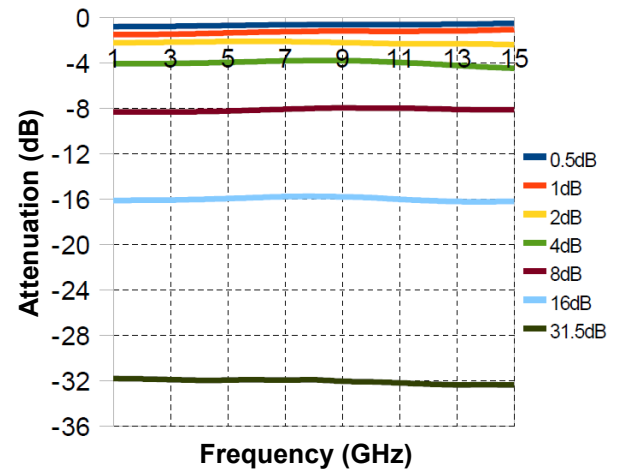
Output Return Loss



Transmission Loss



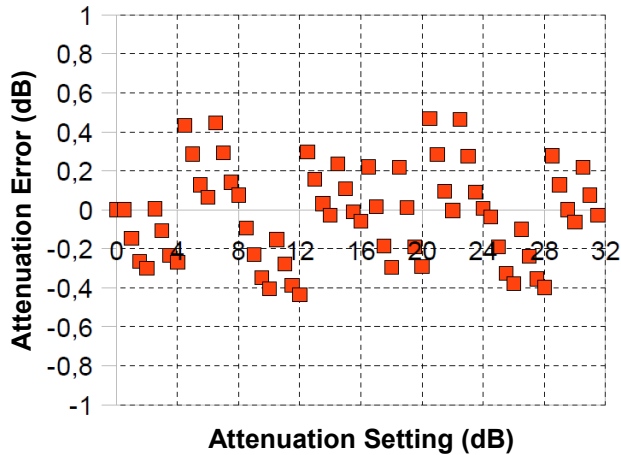
Attenuation



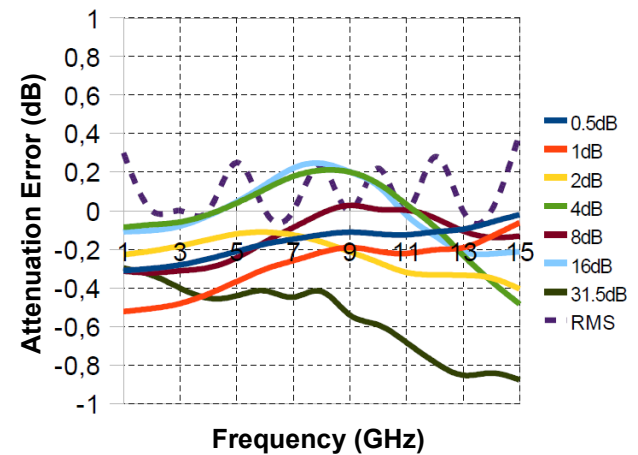
Typical Performance Curves: Attenuation Errors

On Wafer Measurements, calculated with input and output inductance of 0.3 nH

Attenuation Error vs. Attenuation Setting @ 10 GHz



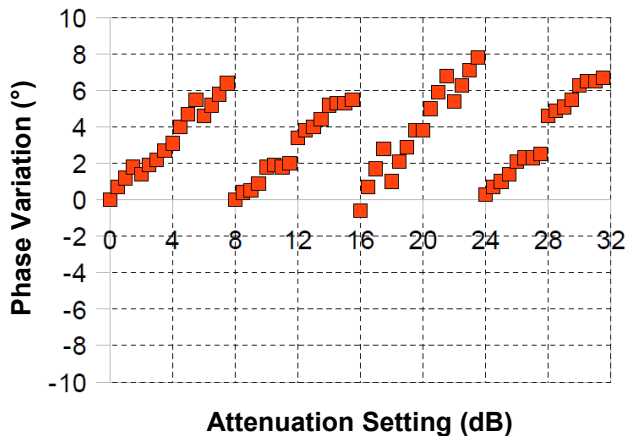
Attenuation Error vs. Frequency



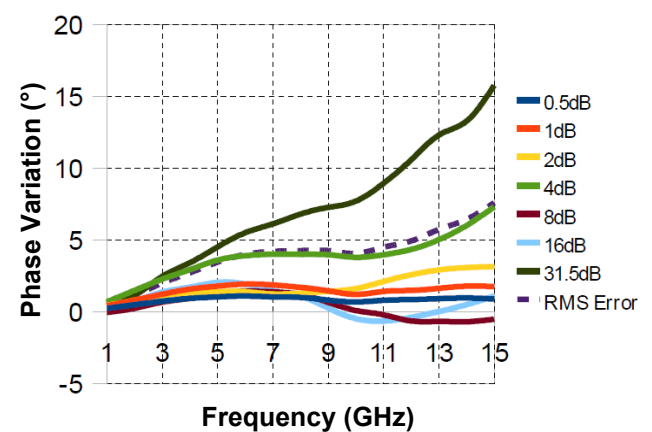
Typical Performance Curves: Phase Shifting Variations

On Wafer Measurements, calculated with input and output inductance of 0.3 nH

Phase Variation vs. Attenuation Setting @ 10 GHz



Phase Variation



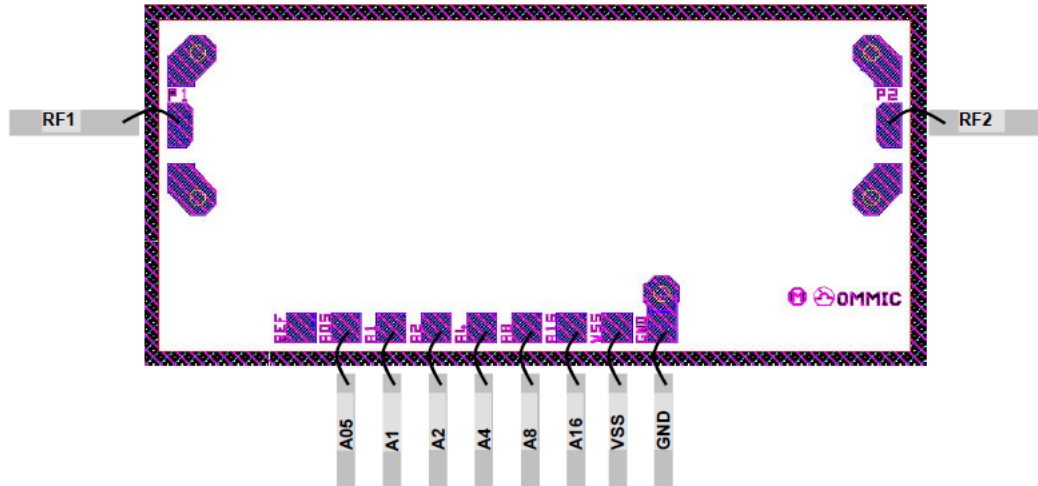
Attenuator, 6-Bit 1 - 15 GHz



CGY2171XBUH/C1

Rev. V1

Bonding Diagram & Assembly Information



RF interface : coplanar or microstrip, bonding $\approx 400/500 \mu\text{m}$.

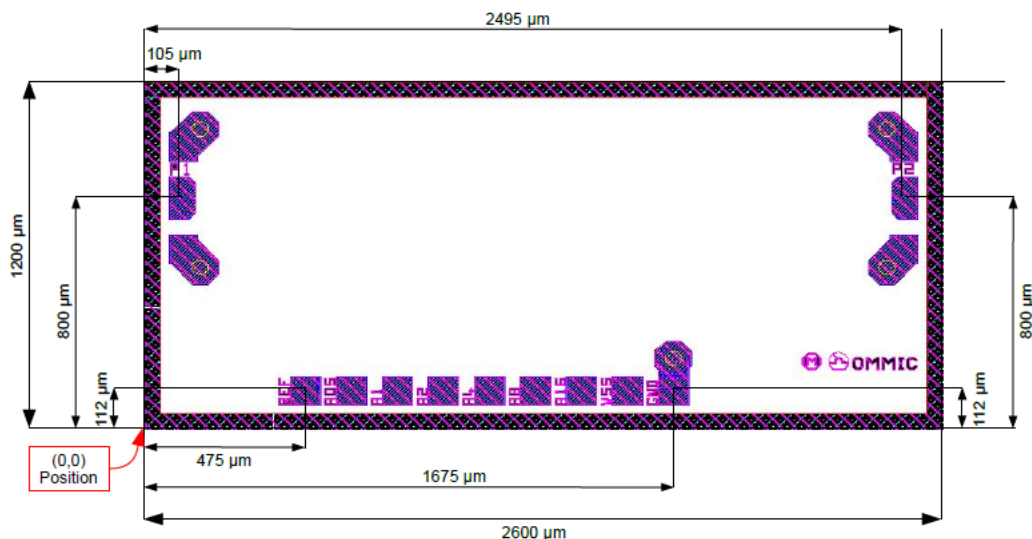
Attenuator, 6-Bit 1 - 15 GHz



CGY2171XBUH/C1

Rev. V1

Mechanical Information



Chip Size = 2600 x 1200 μm (2565 x 1165 μm ± 5 μm)
 DC Pads = 100 x 100 μm, spacing = 150 μm, top metal = Au
 RF Pads = 85 x 150 μm, top metal = Au
 Chip Thickness = 100 μm

Pad Position^{7,8}

Pad Name	Coordinate		Description
	X	Y	
RF1 (P1)	105	800	RF Port 1
RF2 (P2)	2495	800	RF Port 2
REF	475	112	Reference Output Voltage (do not connect)
A05	625	112	0.5 dB cell control
A1	775	112	1 dB cell control
A2	925	112	2 dB cell control
A4	1075	112	4 dB cell control
A8	1225	112	8 dB cell control
A16	1375	112	16 dB cell control
VSS	1525	112	Negative Supply Voltage
GND	1675	112	Ground (connected to MMIC back side metal)

7. X = 0, Y = 0 at bottom left corner.

8. See mechanical information for more detail.

Attenuator, 6-Bit

1 - 15 GHz



CGY2171XBUEH/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.