Attenuator, 6-Bit
1 - 8 GHz

CGY2176AUH/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 @ 14 GHz (All states)
- 0 / 5 V Control Lines
- Chip Size = 2600 x 1200 µm ± 5 µm
- Tested, Inspected Known Good Die (KGD)
- Samples Available
- Demonstration Boards Available
- Space and MIL-STD Available
- RoHS* Compliant

Applications

- Radar
- Telecommunication
- Instrumentation
- Space Rated Applications

Description

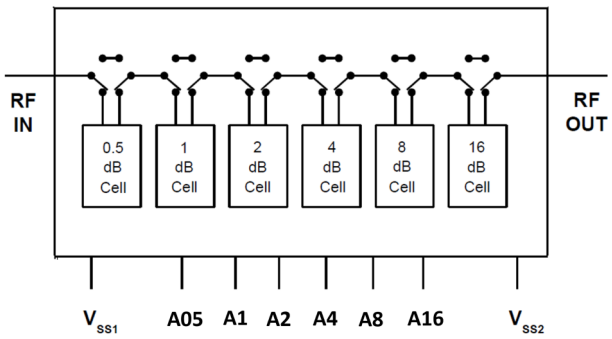
The CGY2176AUH/C1 is a high performance GaAs MMIC 6-bit attenuator operating in L, S, C, and X band.. This device has a nominal attenuation range of 31.5 dB in 0.5 dB steps. It covers the frequency range of 1 to 15 GHz.

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.

Ordering Information

Part Number	Package
CGY2176AUH	DIE

Block Diagram



Pad Configuration[1,2]

Pad #	Function
Port 1	RF Input
Port 2	RF Output
REF	Reference Output Voltage (do not connect)
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
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.

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

Electrical Specifications: Measured On Wafer
Freq. = 5.4 GHz, V_{SS2} = -4.5 V, I_{SS2} = 8 mA, T_A = +25°C

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Source Supply Voltage	V_{SS2}, V_{SS1} Pad is Open V_{SS1}, V_{SS2} Pad is Open	V	-6.0 -5.0	-4.5 -3.5	-4.0 -3.0
Insertion Loss (Reference State)	—	dB	—	5.6	—
Attenuation Range	—	dB	—	31.5	—
Input & Output Return Loss	All States, 50 Ω Source, 50 Ω Load	dB	—	-15	—
RMS Attenuation Error [3]	—	dB	—	0.2	—
RMS Phase Error [3]	—	°	—	1.3	—
P1dB	—	dBm	—	25	—

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.

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

Absolute Maximum Ratings[4,5]

Parameter	Absolute Maximum
Attenuation Control Inputs	6 V
Source Supply Voltage V_{SS2} Pad is Open V_{SS1} Pad is Open	 -5.0 to 0.5 V -6.0 to 0.5 V
Input Power	30 dBm
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

Signal Name	A05	A1	A2	A4	A8	A16
Nominal Attenuation	0.5 dB	1 dB	2 dB	4 dB	8 dB	16 dB
Pad Name[6]	B0	B1	B2	B3	B4	B5
Attenuation Activated	1	1	1	1	1	1
Reference State	0	0	0	0	0	0

Logic Truth Table (V)

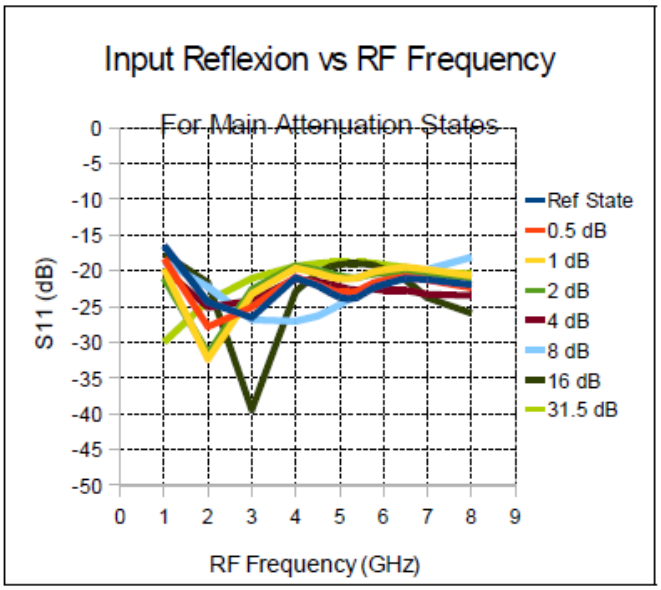
Signal Name	A05	A1	A2	A4	A8	A16
Attenuation (dB)	**0.5**	**1**	**2**	**4**	**8**	**16**
0	0	0	0	0	0	0
0.5	1	0	0	0	0	0
1	0	1	0	0	0	0
2	0	0	1	0	0	0
4	0	0	0	1	0	0
5	0	1	0	1	0	0
8	0	0	0	0	1	0
10	0	0	1	0	1	0
15	1	1	1	1	1	0
16	0	0	0	0	0	1
20	0	0	0	1	0	1
25	0	1	0	0	1	1
30	0	0	1	1	1	1
31.5	1	1	1	1	1	1

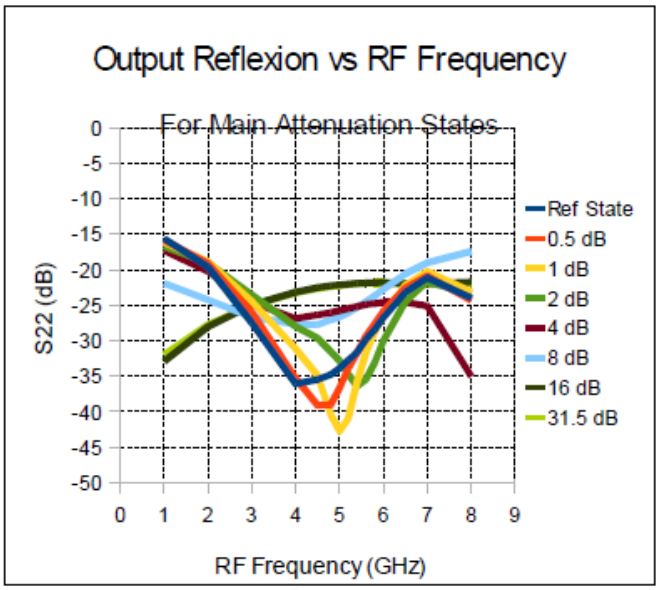
Control Voltage

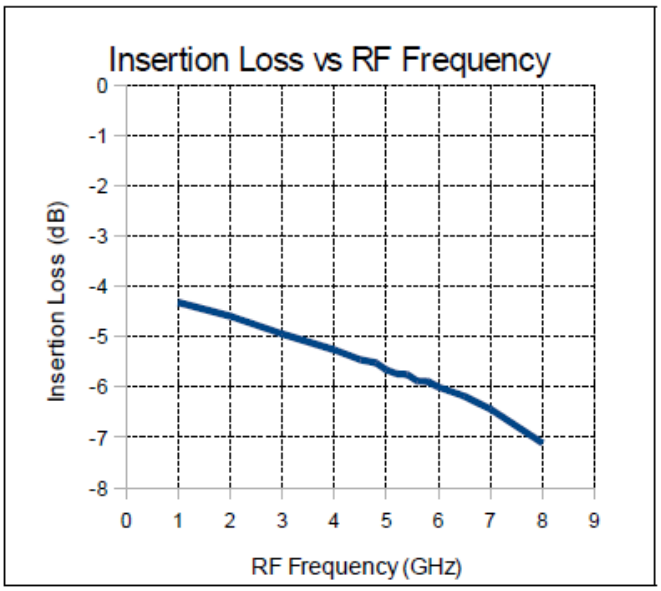
State	Min.	Typ.	Max.	Unit
Low (0)	0	—	1	V
High (1)	4	—	6	V

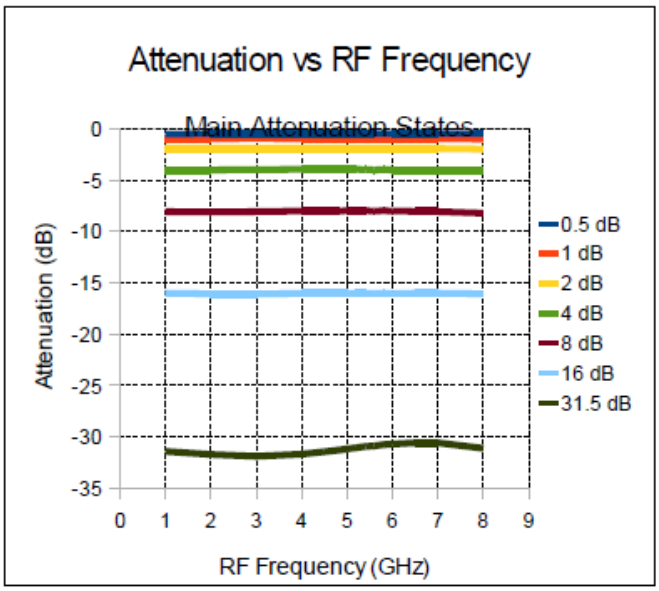
6. See die drawing on page 7 for proper die pad names

Typical Performance Curves: On Wafer Measurement Results[7], V_{SS2} = -4.5 V









7. Measurement data de-embedded for input & output probe inductance of 0.3 nH

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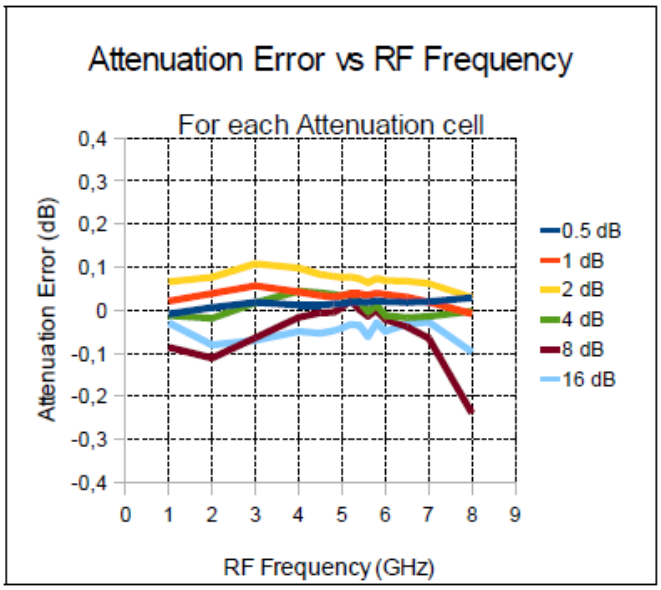

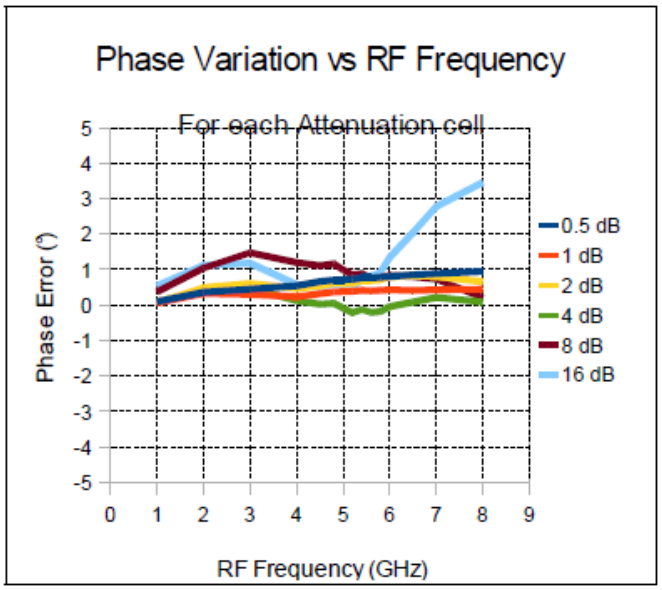

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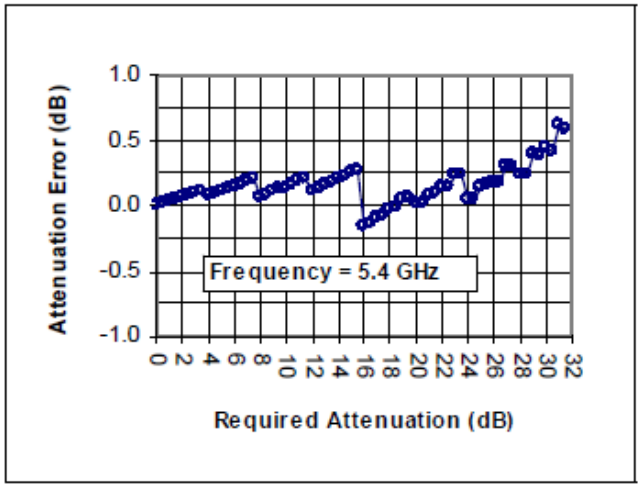

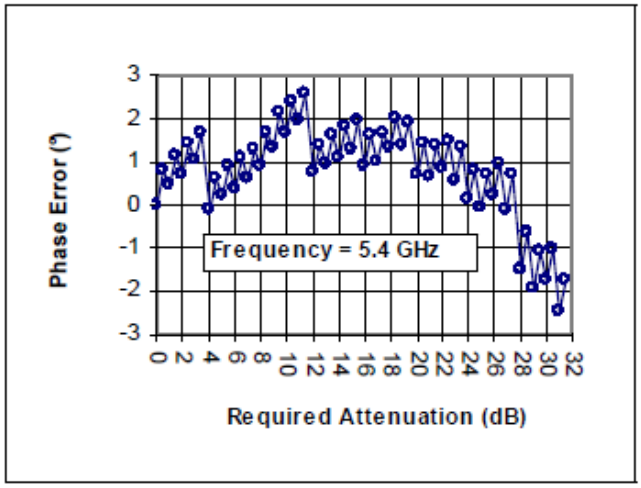

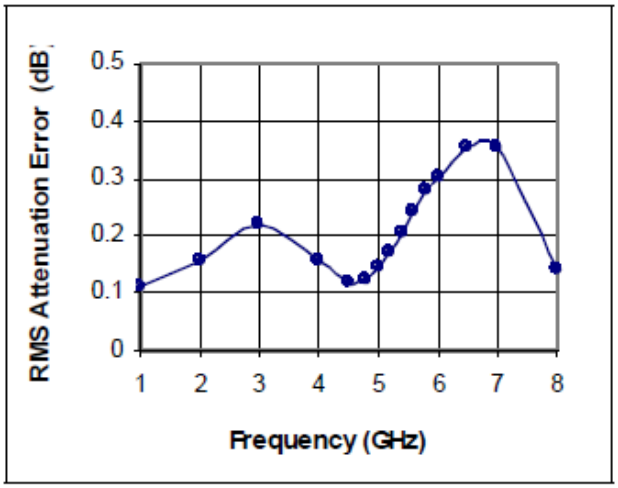

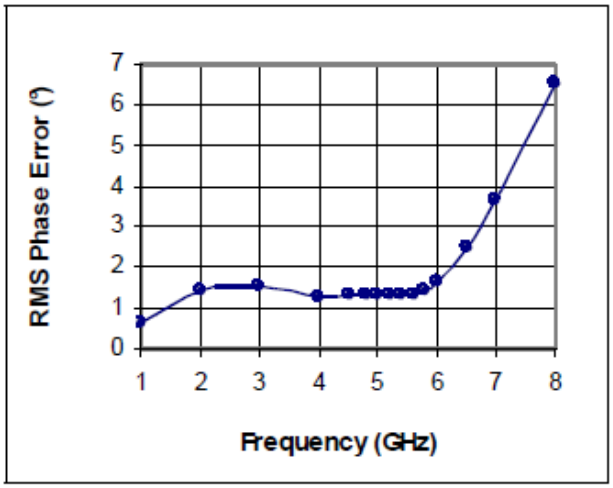

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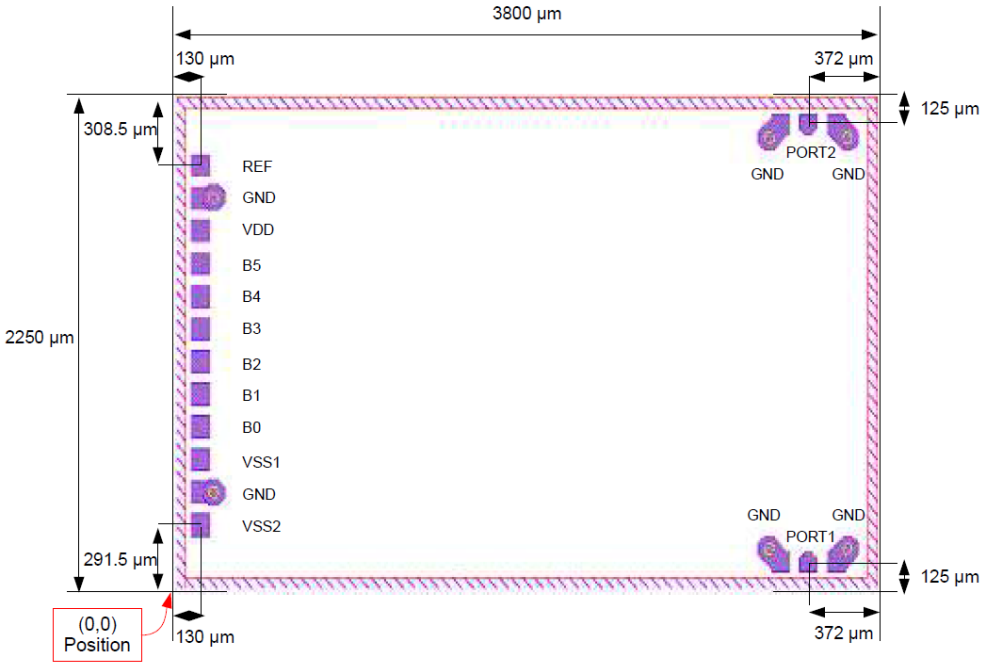

Chip Size = 3800 x 2250 µm (± 5 µm)
DC Pads = 100 x 100 µm, spacing = 150 µm, top metal = Au
RF Pads = 100 x 100 µm, top metal = Au
Chip Thickness = 100 µm

Pad Position[8,9]

Pad Name	Signal	Coordinate		Description
		X	Y	
Port 1	RF_{IN}	3428	125	RF Input
Port 2	RF_{OUT}	3428	2125	RF Output
VSS2	V_{SS2}	130	291.5	V_{SS2} Supply Voltage, V_{SS1} not connected
GND	GND	130	441.5	Ground (connected to MMIC back side metal)
VSS1	V_{SS1}	130	591.5	V_{SS1} Supply Voltage, V_{SS2} not connected
B0	A05	130	741.5	0.5 dB cell control
B1	A1	130	891.5	1 dB cell control
B2	A2	130	1041.5	2 dB cell control
B3	A4	130	1191.5	4 dB cell control
B4	A8	130	1341.5	8 dB cell control
B5	A16	130	1491.5	16 dB cell control
VDD	V_D	130	1641.5	Do Not Use
GND	GND	130	1791.5	Ground (connected to MMIC back side metal)
REF	V_{REF}	130	1941.5	-3 V DC voltage available at this pad, (Do Not Connect)

8. Only V_{SS1} or V_{SS2} is to be connected. For example, if V_{SS2} is connected, V_{SS1} must be left open.
9. The power supply (V_{SS1} or V_{SS2}) and REF must be decoupled to the ground with 100 nF capacitors as close as possible to the chip.