Attenuator, 6-Bit
10 - 18 GHz

CGY2169UH/C1
Rev. V1

Features

- Insertion Loss: 4 dB @ 14 GHz
- Attenuation Range: 23.5 dB
- RMS Attenuation Error: 0.4 dB @ 14 GHz
- Input P1dB: 20 dBm
- Return Loss: < -10 dB @ 14 GHz (All states)
- Parallel 0 / -3.3 V Control Logic
- 2600 x 1100 µm ±5 µm
- Tested and Inspected
- Samples Available
- Evaluation Boards Available
- Space and MIL-STD Available
- RoHS* Compliant

Applications

- Radar
- Telecommunication
- Instrumentation
- Space applications

Description

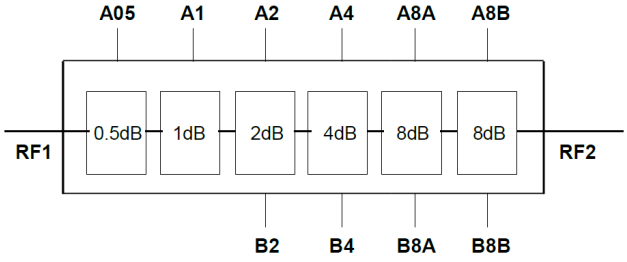
The CGY2169UH/C1 is a high performance GaAs MMIC 6-bit attenuator covering 10 - 18 GHz. This device has a nominal attenuation range of 23.5 dB in 0.5 dB steps. Employs complimentary control logic for parallel control of the four most significant attenuation levels to improve matching and drive levels.

The die is manufactured using 0.18 µm gate length pHEMT Technology. This MMIC features gold bond pads 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
CGY2169UH/C1	Die

Block Diagram



Pad Configuration[1]

Pad #	Function
IN	RF Port 1
OUT	RF Port 2
C8A	8 dB cell control
C8B	8 dB cell control
C2A	2 dB cell control
C2B	2 dB cell control
C05	0.5 dB cell control
C1	1 dB cell control
C4A	4 dB cell control
C4B	4 dB cell control
C8AA	8 dB cell control
C8BB	8 dB cell control
GND[2]	Ground (back Side)

1. Die pad names shown. See Configuration Table on page 3 for correspondence with the block diagram shown above.
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. = 14 GHz, T_A = +25°C

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Insertion Loss	—	dB	—	4	—
Noise Figure	@ Reference State	dB	—	4	—
Attenuation Range	—	dB	—	23.5	—
Input Return Loss	@ RF1	dB	—	-15	-10
Output Return Loss	@ RF2	dB	—	-20	-15
RMS Attenuation Error with Attenuation Setting[3]	—	dB	—	0.4	—
Maximum Attenuation Error with Attenuation Setting	—	dB	—	±1	—
RMS Phase Error with Attenuation Setting[3]	—	deg	—	11	—
Maximum Phase Error with Attenuation Setting	—	deg	—	±20	—
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 theoretical value, x_i is the mean value of the N x_i, and σx_i is the standard deviation of x_i.

$$x_{RMS} = \sqrt{\frac{1}{N}\sum_{i=1}^{N} x_i^2} = \sqrt{\bar{x}_i^{\,2} + \sigma_{x_i}^2}$$

Absolute Maximum Ratings[4,5]

Parameter	Absolute Maximum
Attenuation Control Inputs	-4.7 to 0 V
Input Power @ RF1	28 dBm
Junction Temperature	+150°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.

Operating Conditions

Parameter	Maximum
Attenuation Control Inputs	-4.0 to 0 V
Input Power @ RF1	19 dBm
Operating Temperature	-40°C to +85°C

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.

Configuration Table

Signal Name	A05	A1	A2	B2	A4	B4	A8A	B8A	A8B	B8B
Nominal Attenuation	0.5 dB	1 dB	2 dB	2 dB	4 dB	4 dB	8 dB	8 dB	8 dB	8 dB
Die Pad Name	C05	C1	C2A	C2B	C4A	C4B	C8A	C8B	C8AA	C8BB
Active Logic Level	High	High	High	Low	High	Low	High	Low	High	Low
Reference State	Low	Low	Low	High	Low	High	Low	High	Low	High

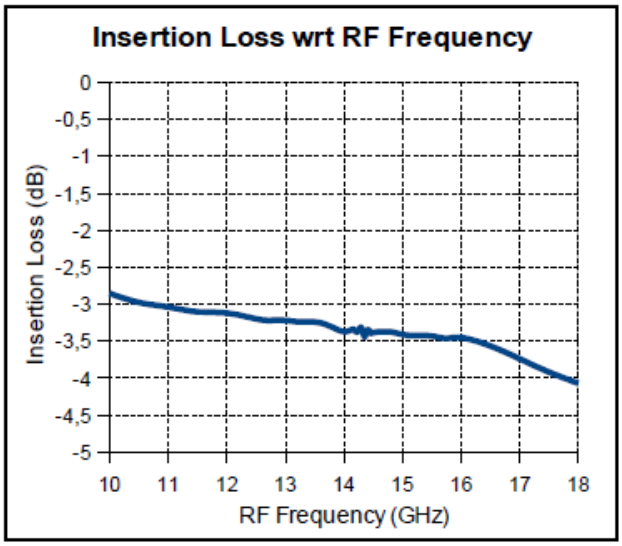
Truth Table

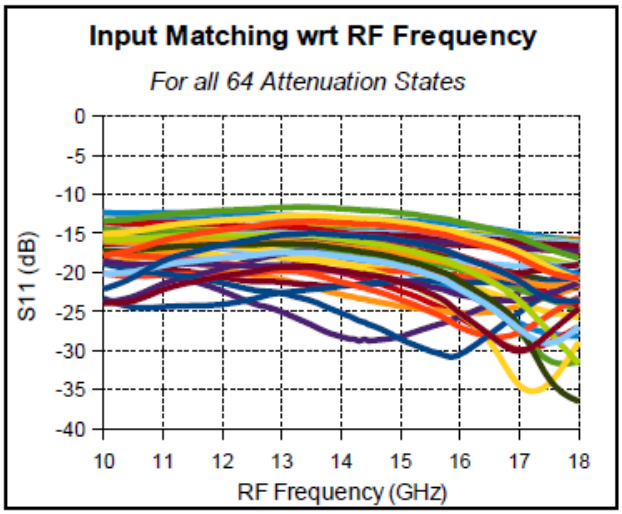
Signal Name	A05	A1	A2	B2	A4	B4	A8A	B8A	A8B	B8B
Attenuation (dB)	**0.5**	**1**	**2**	**2**	**4**	**4**	**8**	**8**	**8**	**8**
0	Low	Low	Low	High	Low	High	Low	High	Low	High
0.5	High	Low	Low	High	Low	High	Low	High	Low	High
1	Low	High	Low	High	Low	High	Low	High	Low	High
2	Low	Low	High	Low	Low	High	Low	High	Low	High
4	Low	Low	Low	High	High	Low	Low	High	Low	High
8A	Low	Low	Low	High	Low	High	High	Low	Low	High
8B	Low	Low	Low	High	Low	High	Low	High	High	Low
10A	Low	Low	High	Low	Low	High	High	Low	Low	High
10B	Low	Low	High	Low	Low	High	Low	High	High	Low
16	Low	Low	Low	High	Low	High	High	Low	High	Low
23.5	High	High	High	Low	High	Low	High	Low	High	Low

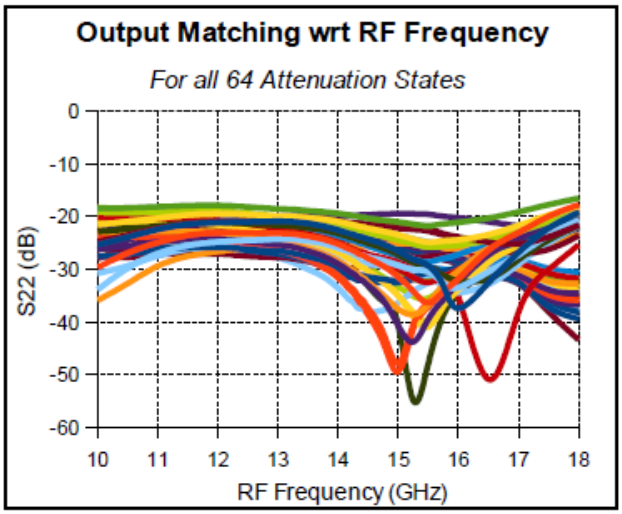
Logic Levels (V)

State	Min.	Typ.	Max.	Unit
Low	-3.6	-3.3	-2.99	V
High	-0.1	0	+0.1	V

Typical Performance Curves: On Wafer Measurement Results[6]







6. Measurements de-embedded for a probe inductance of 0.3 nH at both input and output.

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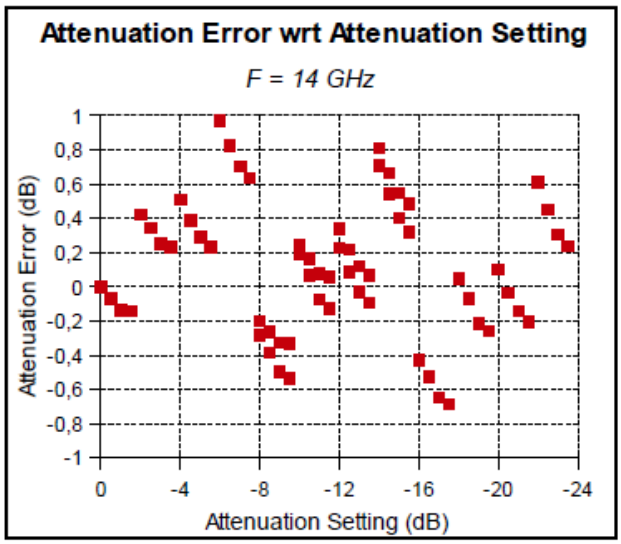

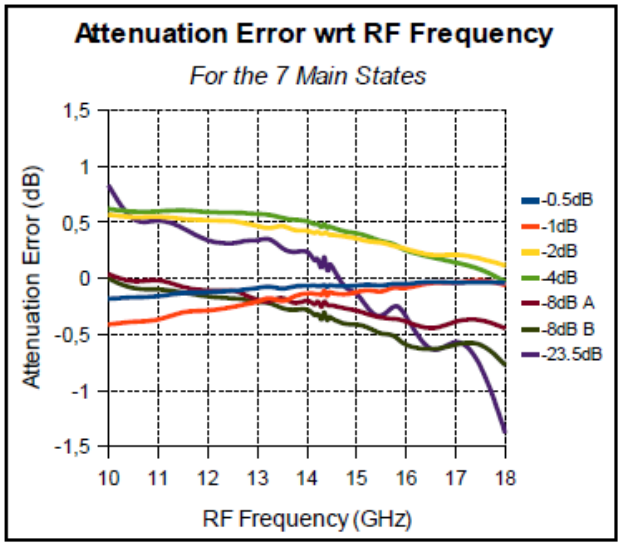

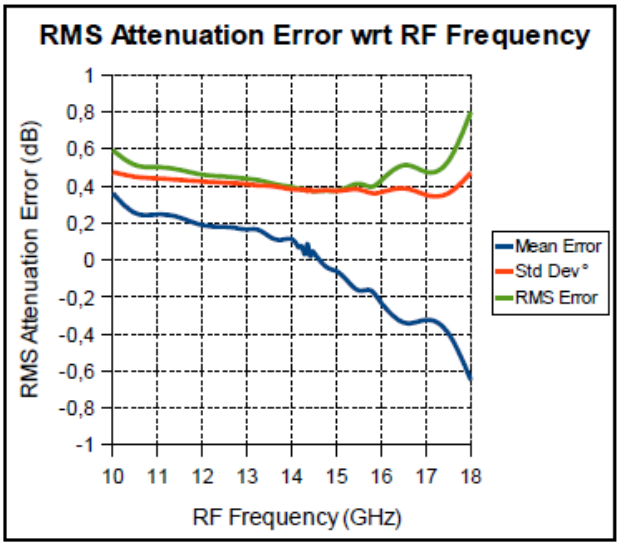

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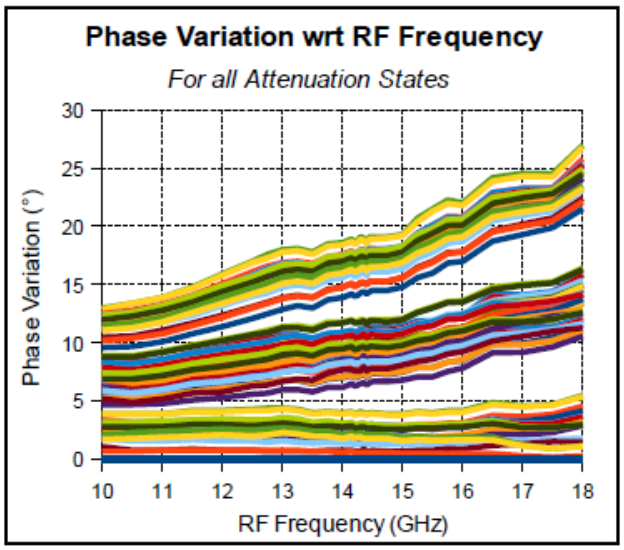

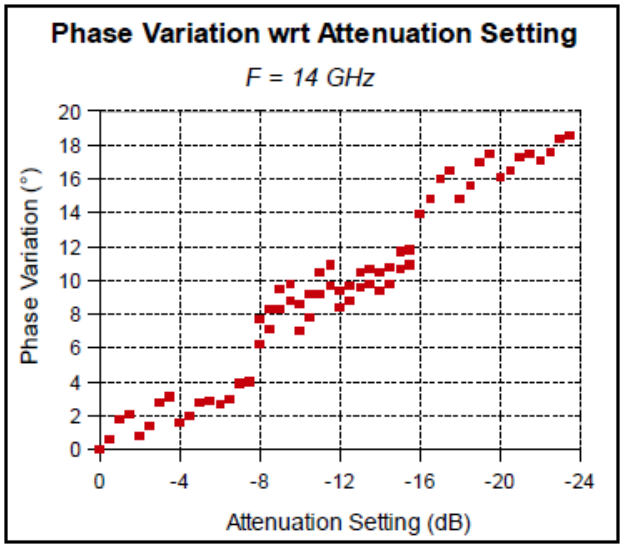

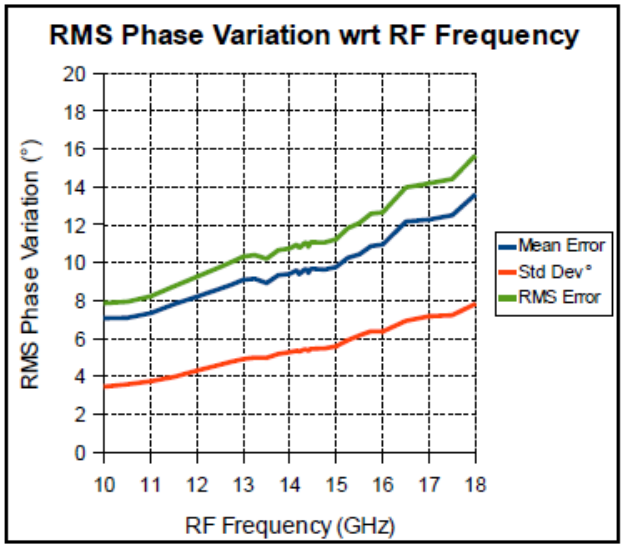

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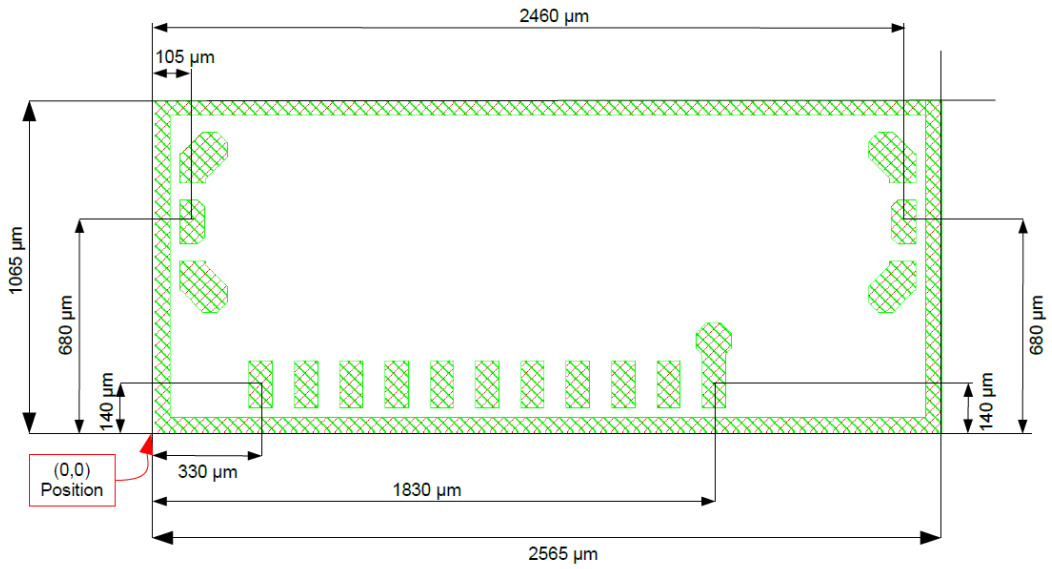

Chip Size = 2600 x 1100 µm (2565 x 1065 µm ± 5 µm after dicing)
DC Pads = 80 x 160 µm, spacing = 70 µm, top metal = Au
RF Pads = 85 x 150 µm, top metal = Au
Chip Thickness = 100 µm

Pad Position[7]

Pad Name	Signal Name	Coordinate		Description
		X	Y	
IN	RF1	105	680	RF Port 1
OUT	RF2	960	680	RF Port 2
C8A	A8A	330	140	8 dB cell control
C8B	B8A	480	140	8 dB cell control
C2A	A2	630	140	2 dB cell control
C2B	B2	780	140	2 dB cell control
C05	A05	930	140	0.5 dB cell control
C1	A1	1080	140	1 dB cell control
C4A	A4	1230	140	4 dB cell control
C4B	B4	1380	140	4 dB cell control
C8AA	A8B	1530	140	8 dB cell control
C8BB	B8B	1680	140	8 dB cell control
GND	GND	1830	140	Ground Paddle

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