Attenuator, 3-Bit
6 - 18 GHz

CGY2390SUH/C1
Rev. V1

Features

- Insertion Loss: 2.2 dB @ 12 GHz
- Attenuation Range: 35 dB
- RMS Attenuation Error: 0.2 dB @ 12 GHz
- Input P1dB: 25 dBm
- Return Loss: < -19 dB
- 0 / 5 V Control Lines
- Chip Size = 1800 x 1200 µm ±5 µm
- Tested, Inspected Known Good Die (KGD)
- Samples Available
- Space and MIL-STD Available
- RoHS* Compliant

Applications

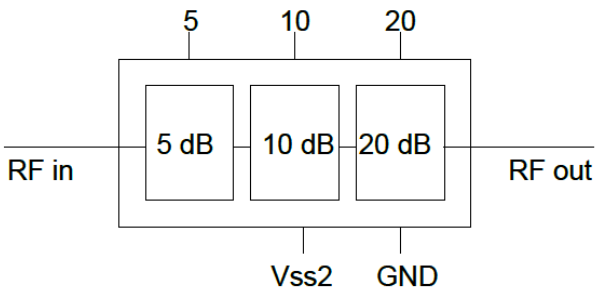
- Radar
- Telecommunication
- Instrumentation

Description

The CGY2390SUH/C1 is a high performance GaAs MMIC 3-Bit attenuator operating from 6 GHz up to 18 GHz. This device has an attenuation range of 35 dB with 5 dB steps. This device is part of a new 6 - 18 GHz chipset that is dedicated to Radar, Telecommunication, & Instrumentation applications.

The die is manufactured using the ED02AH 0.18 µm gate length pHEMT process. The MMIC uses gold bond pads, 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
RF_{IN}	RF Input
RF_{OUT}	RF Output
5	5 dB cell control
10	10 dB cell control
20	20 dB cell control
VSS	VSS Supply Voltage
VSS2	VSS2 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
CGY2390SUH/C1	Die

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

Electrical Specifications: Measured On Wafer
Freq. = 12 GHz, V_{SS2} = -5 V, I_{SS2} = 11 mA, T_A = +25°C

Parameter	Test Conditions	Units	Min.	Typ.	Max.
Source Supply Voltage	V_{SS} Pad is Open V_{SS2} Pad is Open	V	-7.0 -5.0	-5.0 -3.5	-4.0 -3.0
Insertion Loss	—	dB	—	2.2	—
Attenuation Range	—	dB	—	35	—
Input Return Loss	All States, 50 Ω Source	dB	—	-15	—
Output Return Loss	All States, 50 Ω Load	dB	—	-16	—
RMS Attenuation Error [3]	—	dB	—	0.2	—
RMS Phase Error [3]	—	°	—	14	—
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	0 to 5.5 V
Source Supply Voltage V_{SS2} Pad is Open V_{SS1} Pad is Open	 -5.0 to 0.5 V -7.0 to 0.5 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

	5	10	20
Nominal Attenuation	5 dB	10 dB	20 dB
Pad	5	10	20
Attenuation Activated	High (1)	High (1)	High (1)
Reference State	Low (0)	Low (0)	Low (0)

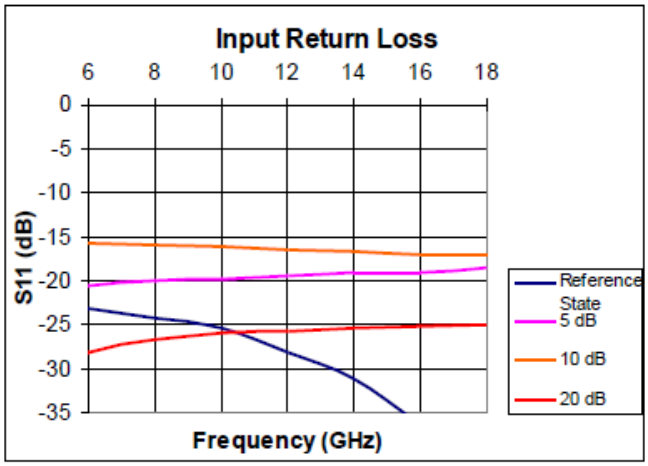
Logic Truth Table (Detailed)

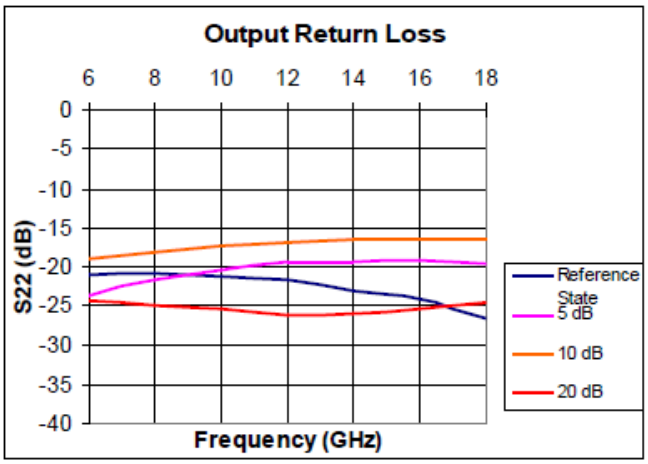
	5	10	20
Attenuation (dB)	**5 dB**	**10 dB**	**20 dB**
0	0	0	0
5	1	0	0
10	0	1	0
15	1	1	0
20	0	0	1
25	1	0	1
30	0	1	1
35	1	1	1

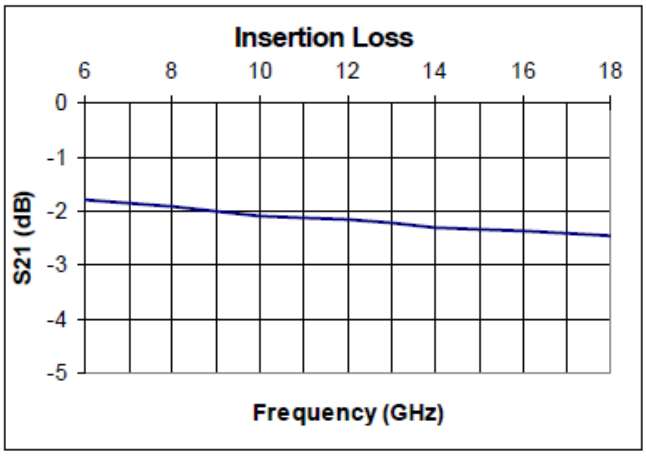
Control Voltage

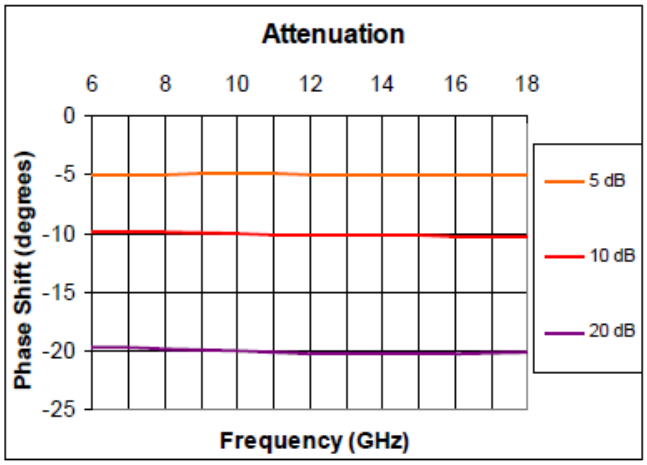
State	Min.	Typ.	Max.	Unit
Low (0)	0	—	1	V
High (1)	4	—	6	V

Typical Performance Curves: V_{SS2} = -5 V
On Wafer Measurements, calculated with input and output inductance of 0.5 nH

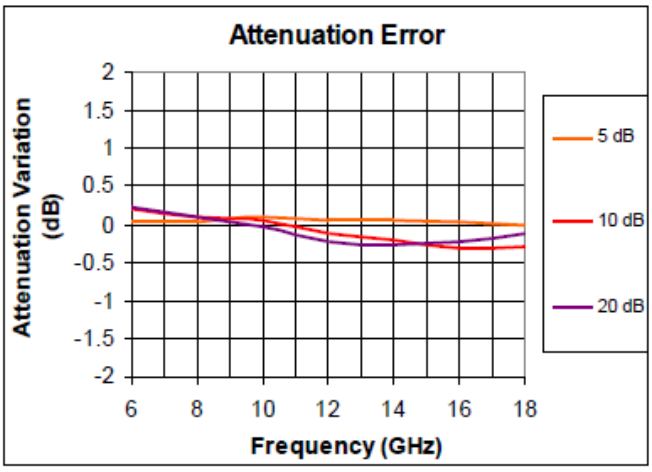


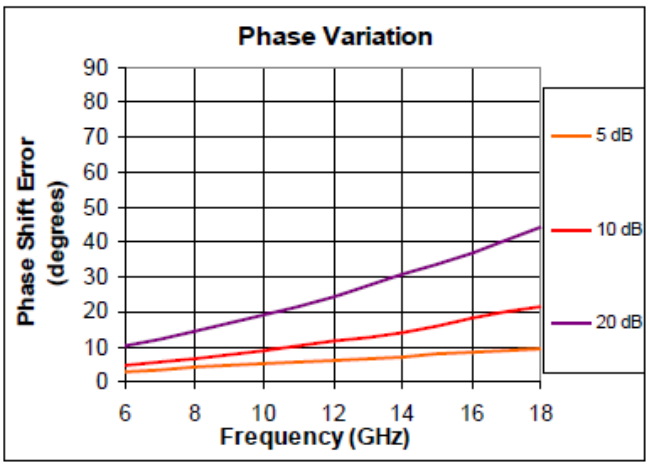


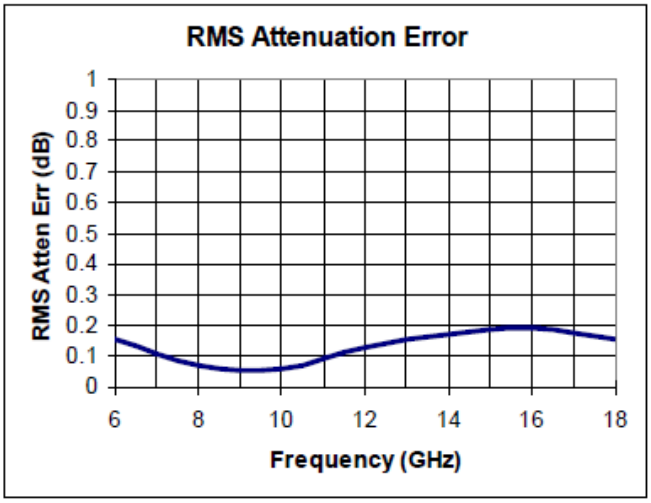


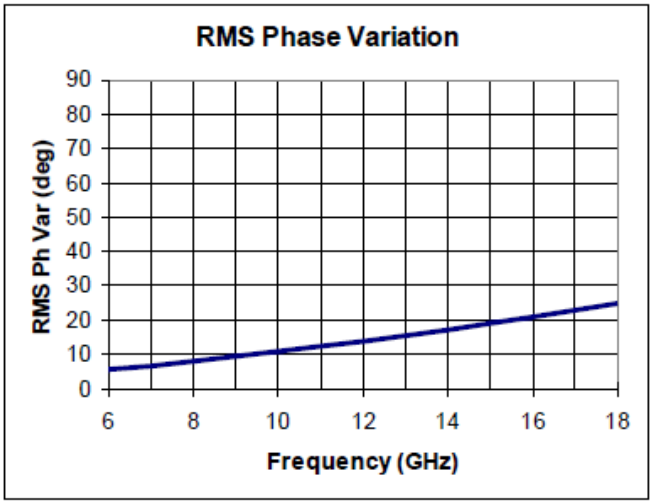


Typical Performance Curves:
On Wafer Measurements, calculated with input and output inductance of 0.3 nH

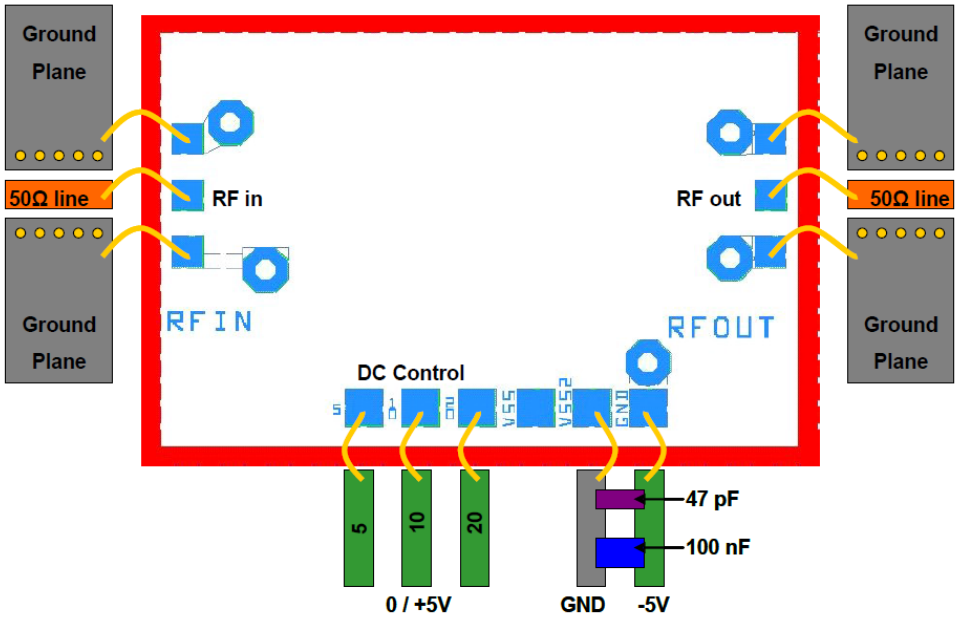








Bonding Diagram & Assembly Information

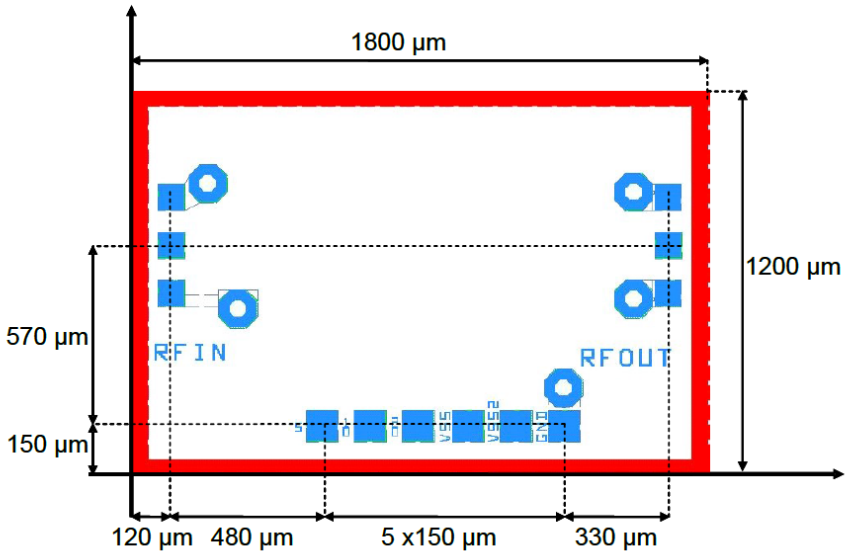


- The RF interfacing bond wires or ribbon should be kept as short as possible.
- The RF lines should be 300um wide or less to minimize discontinuities associated with the connection to the MMIC bond pads.
- The power supply (VSS or VSS2) must be decoupled to the ground with capacitors as close as possible to the chip.

Decoupling Parts List[6]

Parameter	Value
Chip SMD Capacitor 1	47 pF or 100 pF
Chip SMD Capacitor 1	100 nF

6. No decoupling on control pads.



Chip Size = 1800 x 1200 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[7,8]

Pad Name	Coordinate		Description
	X	Y	
GND	120	570	Ground (connected to MMIC back side metal)
RF_{IN}	120	720	RF Input
GND	120	870	Ground (connected to MMIC back side metal)
GND	1680	570	Ground (connected to MMIC back side metal)
RF_{OUT}	1680	720	RF Output
GND	1680	670	Ground (connected to MMIC back side metal)
5	600	150	5 dB cell control
10	750	150	10 dB cell control
20	900	150	20 dB cell control
VSS	1050	150	V_{SS1} Supply Voltage, V_{SS2} not connected
VSS2	1200	150	V_{SS2} Supply Voltage, V_{SS1} not connected
GND	1350	150	Ground (connected to MMIC back side metal)

7. Only V_{SS1} or V_{SS2} is to be connected. For example, if V_{SS2} is connected, V_{SS1} must be left open.
8. 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.