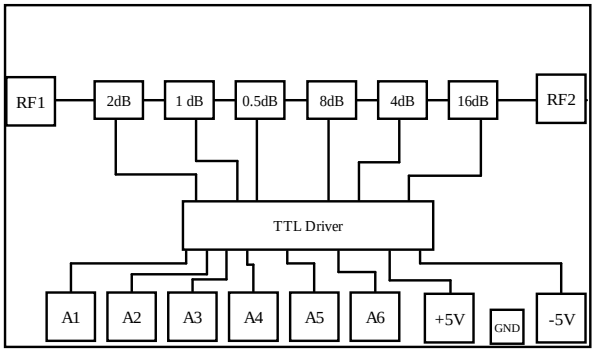
0.5 – 4 GHz 6-Bit Digital Attenuator

Features

- **0.5-4.0 GHz Frequency range**
- **31.5 dB Attenuation range**
- **0.5dB resolution**
- **3.5dB Insertion loss max.**
- **5 deg Phase error over all states**
- **1.5:1 Input/Output VSWR**
- **On-chip TTL integrated control Inputs**
- **0.5µm InGaAs pHEMT Technology**
- **Chip size : 4.05mm x 2.2mm x 0.1 mm**

Functional diagram



Typical Applications

- **Radar Systems**
- **Broadband Communication**
- **Military & Space**
- **Instrumentation Applications**
- **Test and Measurements**

Description

The AMT2321014 is a high performance GaAs MMIC 6-bit digital attenuator offering an attenuation range of 31.5dB in steps of 0.5dB. The attenuator bit values are 0.5(LSB), 1,2,4,8 and 16dB for a total attenuation of 31.5dB. The attenuator features an integrated TTL driver for facilitating a 6–bit digital control. The Driver operates on +5/-5V supplies with minimal DC power consumption. This die is fabricated using a highly reliable 0.5µm InGaAs pHEMT technology and is fully protected with Silicon Nitride passivation for reliable operation.

Absolute Maximum Ratings(1)

Parameter	Absolute Maximum	Units
RF input Power	25	dBm
Positive supply Voltage	+6	V
Negative supply voltage	-6	V
Control voltage	-0.5 to +5.5	V
Operating Temperature	-55 to +85	℃
Storage Temperature	-65 to +150	℃

1. Operation beyond these limits may cause permanent damage to the component

Electrical Specifications @ T_A = 25 °C, Z_o =50Ω

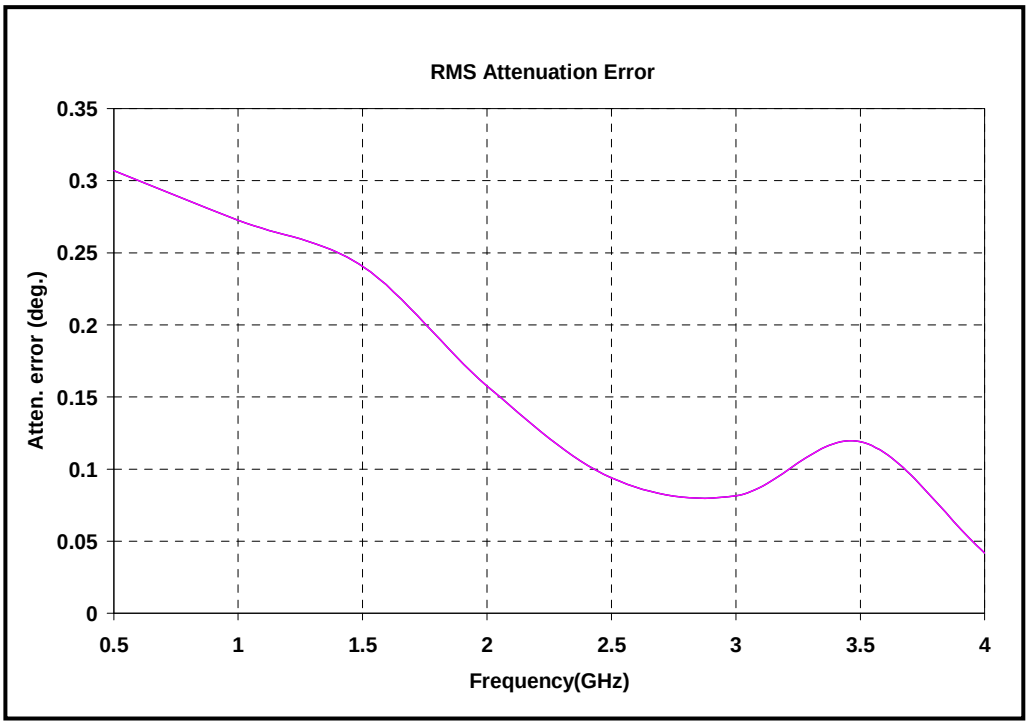
Parameter	Min.	Typ.	Max.	Units
Bandwidth	0.5	-	4.0	GHz
Insertion Loss	-	3	-	dB
Input VSWR,all states	-	1.5:1	-	Ratio
Output VSWR,all states	-	1.5:1	-	Ratio
Attenuation Range	0	-	31.5	dB
Attenuation Accuracy	-	0.6	-	dB
Phase variation, over all states (max.)	-	8	-	deg.
RMS Attenuation error	-	< 0.25	-	dB
Input power @ P-1dB	-	24	-	dBm
Driver Bias Voltages	-	+5, -5	-	V
Control Voltage	-	0/+5	-	V

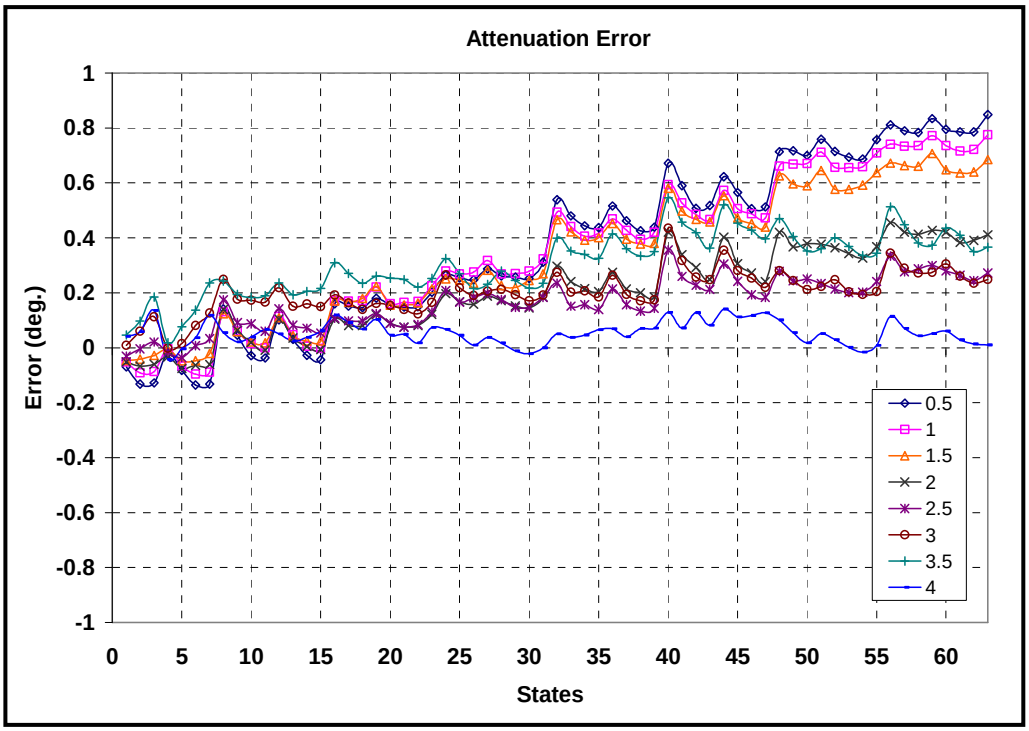
Note:

1. The above mentioned electrical specifications are measured in 50ohm line test fixture.

Test fixture data

Driver Bias +5V,-5V; Control 0/+5V; T_A = 25 ^oC





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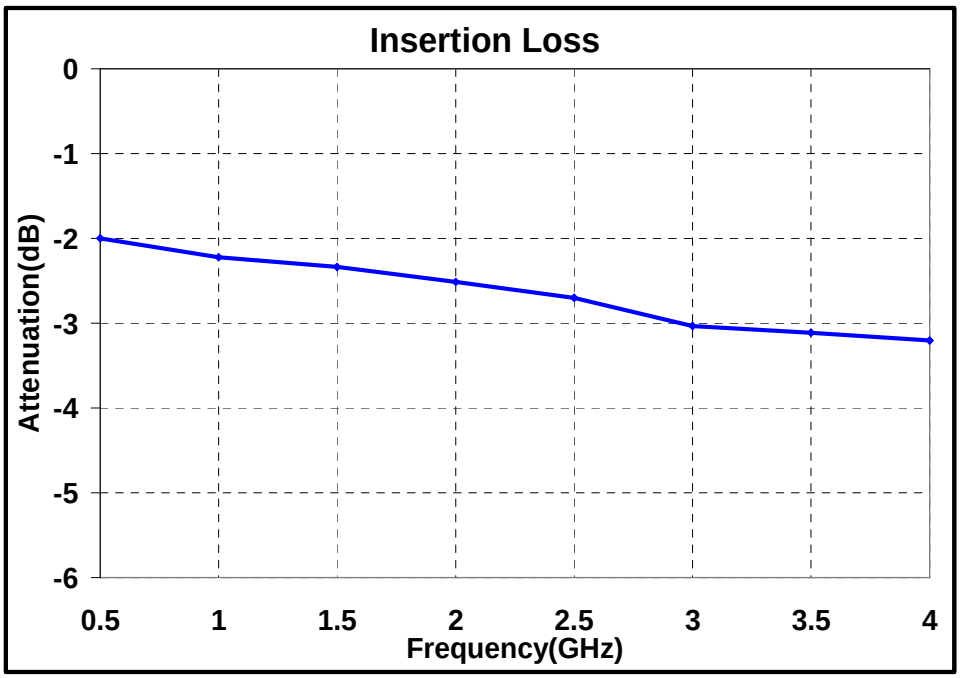

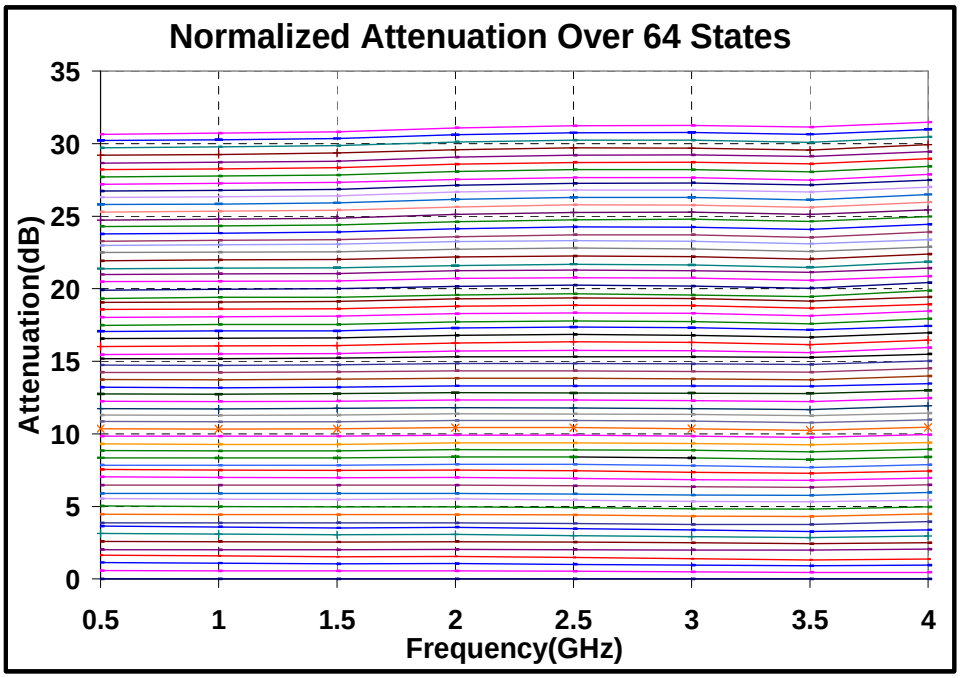

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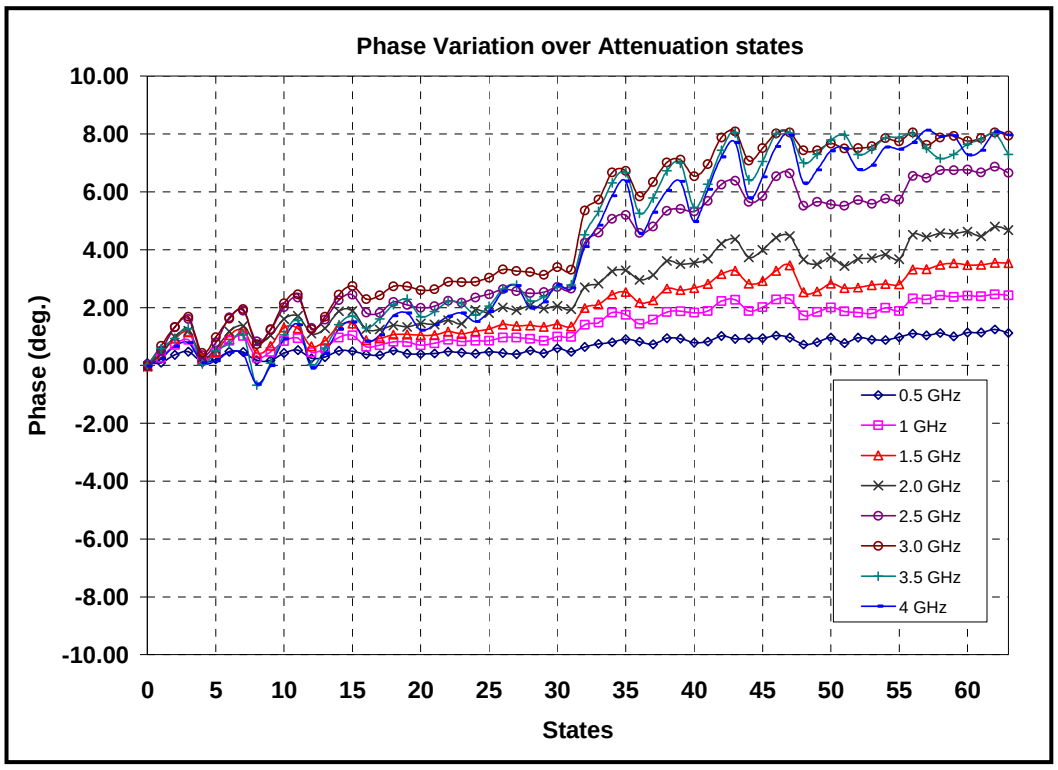
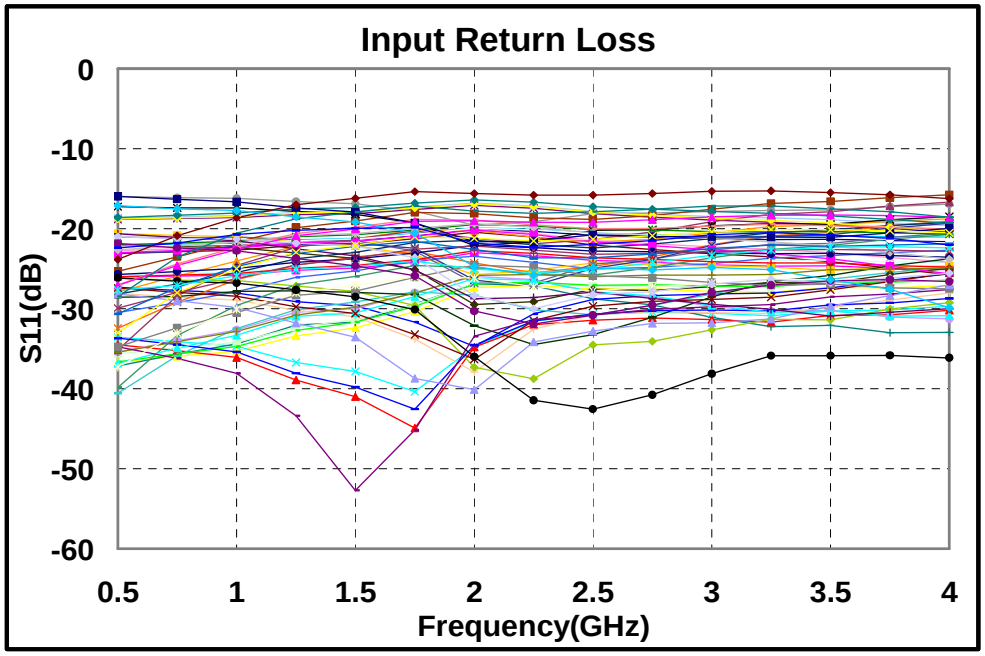
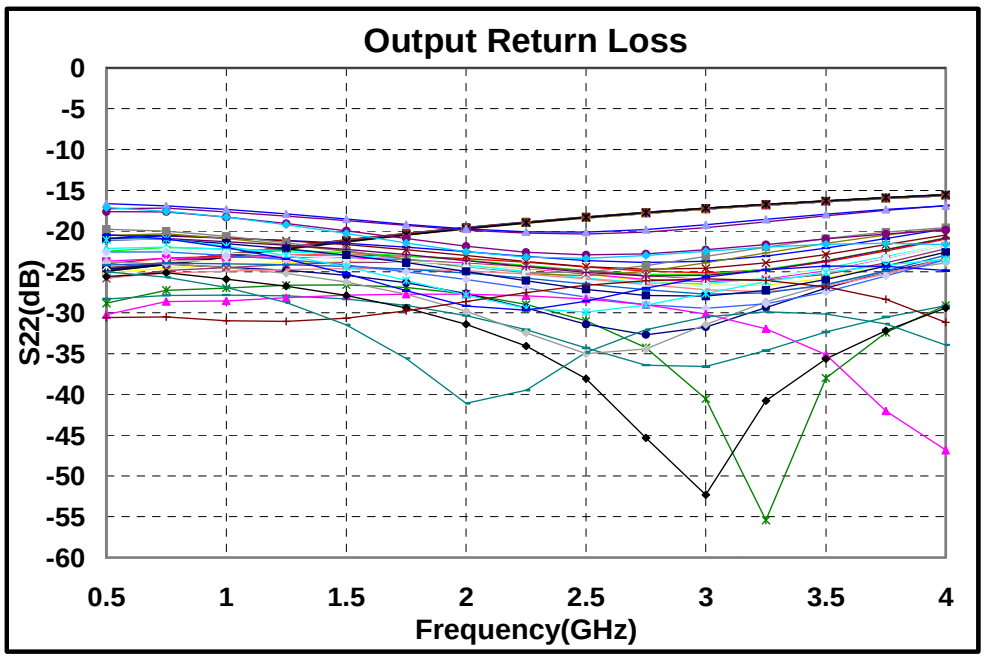


Test fixture data

Driver Bias +5V,-5V; Control 0/+5V; T_A = 25 ^oC





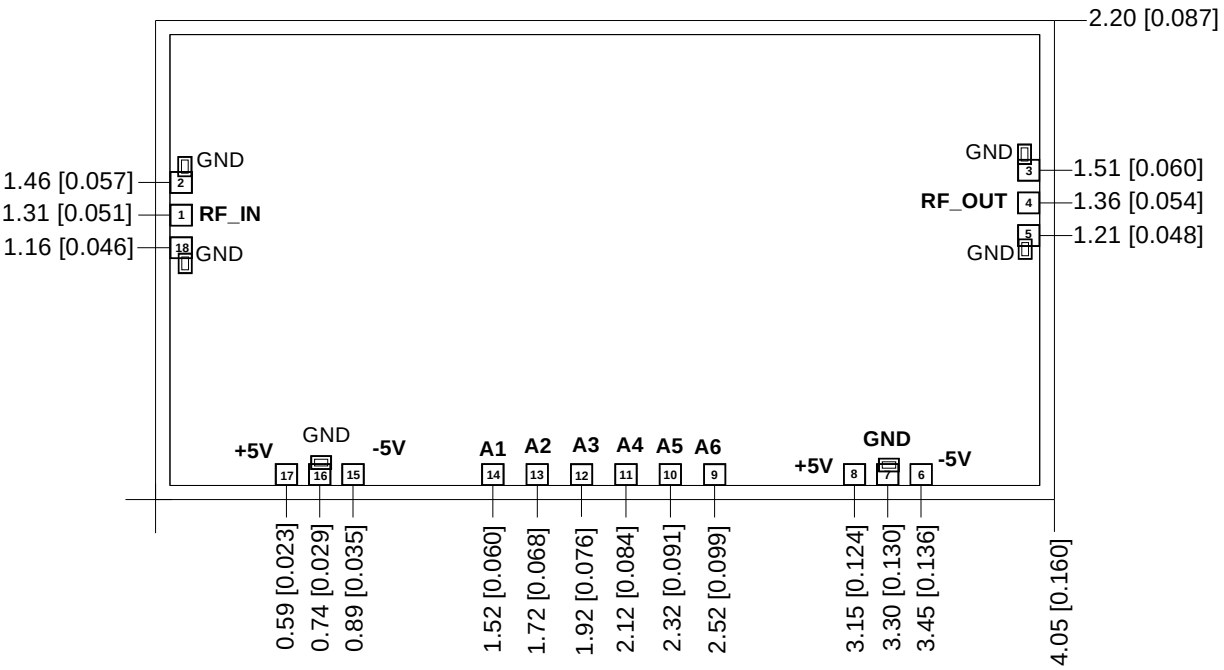
Truth Table

State	Attenuation (dB)	TTL Control (1 = 3.5 to 5 V, 0 = 0 to 0.2 V)					
		A6 (16)	A5 (8)	A4(4)	A3 (2)	A2(1)	A1 (0.5)
0	0	0	0	0	0	0	0
1	0.5	0	0	0	0	0	1
2	1	0	0	0	0	1	0
3	1.5	0	0	0	0	1	1
4	2	0	0	0	1	0	0
5	2.5	0	0	0	1	0	1
6	3	0	0	0	1	1	0
7	3.5	0	0	0	1	1	1
8	4	0	0	1	0	0	0
9	4.5	0	0	1	0	0	1
10	5	0	0	1	0	1	0
11	5.5	0	0	1	0	1	1
12	6	0	0	1	1	0	0
13	6.5	0	0	1	1	0	1
14	7	0	0	1	1	1	0
15	7.5	0	0	1	1	1	1
16	8	0	1	0	0	0	0
17	8.5	0	1	0	0	0	1
18	9	0	1	0	0	1	0
19	9.5	0	1	0	0	1	1
20	10	0	1	0	1	0	0
21	10.5	0	1	0	1	0	1
22	11	0	1	0	1	1	0
23	11.5	0	1	0	1	1	1
24	12	0	1	1	0	0	0
25	12.5	0	1	1	0	0	1
26	13	0	1	1	0	1	0
27	13.5	0	1	1	0	1	1
28	14	0	1	1	1	0	0
29	14.5	0	1	1	1	0	1
30	15	0	1	1	1	1	0
31	15.5	0	1	1	1	1	1
32	16	1	0	0	0	0	0
33	16.5	1	0	0	0	0	1
34	17	1	0	0	0	1	0
35	17.5	1	0	0	0	1	1

Truth Table

State	Attenuation (dB)	TTL Control (1 = 3.5 to 5 V, 0 = 0 to 0.2 V)					
		A6 (16)	A5 (8)	A4(4)	A3 (2)	A2(1)	A1 (0.5)
36	18.0	1	0	0	1	0	0
37	18.5	1	0	0	1	0	1
38	19	1	0	0	1	1	0
39	19.5	1	0	0	1	1	1
40	20	1	0	1	0	0	0
41	20.5	1	0	1	0	0	1
42	21	1	0	1	0	1	0
43	21.5	1	0	1	0	1	1
44	22	1	0	1	1	0	0
45	22.5	1	0	1	1	0	1
46	23	1	0	1	1	1	0
47	23.5	1	0	1	1	1	1
48	24	1	1	0	0	0	0
49	24.5	1	1	0	0	0	1
50	25	1	1	0	0	1	0
51	25.5	1	1	0	0	1	1
52	26	1	1	0	1	0	0
53	26.5	1	1	0	1	0	1
54	27	1	1	0	1	1	0
55	27.5	1	1	0	1	1	1
56	28	1	1	1	0	0	0
57	28.5	1	1	1	0	0	1
58	29	1	1	1	0	1	0
59	29.5	1	1	1	0	1	1
60	30	1	1	1	1	0	0
61	30.5	1	1	1	1	0	1
62	31	1	1	1	1	1	0
63	31.5	1	1	1	1	1	1

Mechanical Characteristics



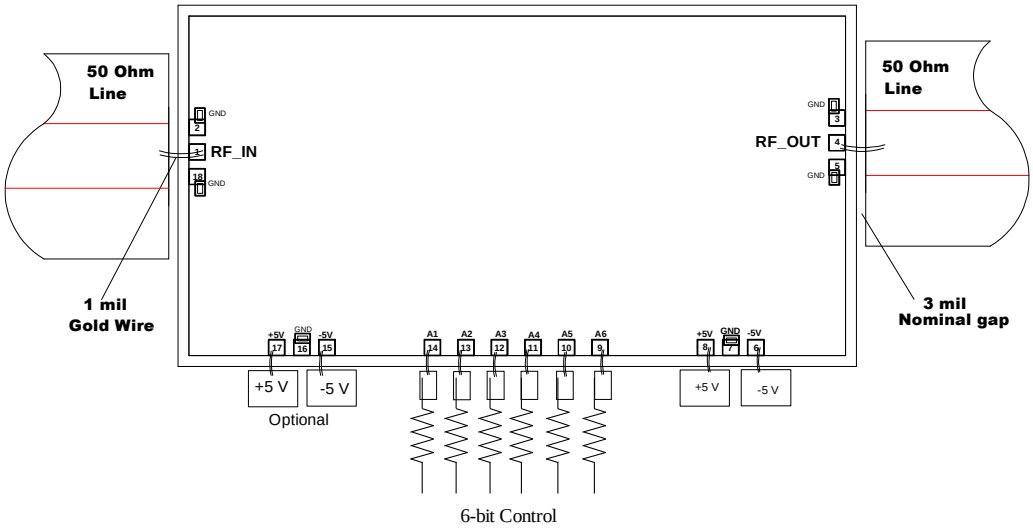
Units: millimetres (inches)

All RF and DC bond pads are 100µm x 100µm

Note:

1. **Pad no. 1 : RF_IN**
2. **Pad no. 4 : RF_OUT**
3. **Pad no. 6 : -5V**
4. **Pad no. 8 : +5V**
5. **Pad nos. 9 – 14 : Control pads ; Pad 9 - MSB (16 dB) ; Pad 14 - LSB (0.5dB)**
6. **Pad no. 15 : optional -5V**
7. **Pad no. 17 : optional +5V**

Recommended Assembly Diagram



Note:

1. The RF input & output ports are DC coupled.
2. For reliable operation external DC blocking capacitors are required at the RF input & out ports.
3. It is recommended to use 100-200 Ω resistors in the control path as shown.

Die attach: For Epoxy attachment, use of a two-component conductive epoxy is recommended. An epoxy fillet should be visible around the total die periphery. If Eutectic attachment is preferred, use of fluxless AuSn (80/20) 1-2 mil thick preform solder is recommended. Use of AuGe preform should be strictly avoided.

Wire bonding: For DC pad connections use either ball or wedge bonds. For best RF performance, use of 150 - 200µm length of wedge bonds is advised. Single Ball bonds of 250-300µm though acceptable, may cause a deviation in RF performance.

GaAs MMIC devices are susceptible to Electrostatic discharge. Proper precautions should be observed during handling, assembly & testing

All information and Specifications are subject to change without prior notice