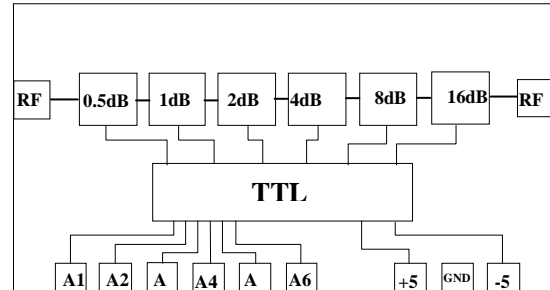


## 0.5 – 10.5 GHz 6-Bit Digital Attenuator

### Features

- ◆ Frequency Range : 0.5 to 10.5 GHz
- ◆ 31.5dB Attenuation Range
- ◆ 5.2dB Insertion loss max.
- ◆ 0.5dB RMS attenuation error
- ◆ 23° max. phase variation
- ◆ 1.6:1 Input\Output VSWR
- ◆ TTL Control Inputs
- ◆ 0.5µm InGaAs pHEMT Technology
- ◆ Chip Size : 4.0 mm x 2.2 mm x 0.1 mm

Functional Diagram



### Typical Applications

- ◆ Radar
- ◆ Military & Space
- ◆ Instrumentation
- ◆ Test and Measurements
- ◆ Instrumentation Applications

### Description

The AMT2341011 is a high performance 6-bit digital attenuator MMIC offering an attenuation range of 31.5dB in steps 0.5dB. The attenuator bit values are 0.5dB (LSB), 1,2,4,8 and 16dB (MSB) with a total attenuation of 31.5dB. The attenuator features good attenuation accuracy of  $\pm 0.5$ dB over 0.5-6GHz frequency band. The attenuator provides an integral TTL driver, facilitating a 6-bit control. The driver operates on +5/-5V voltages with minimal DC power consumption. The MMIC die is fabricated using a robust 0.5µm InGaAs pHEMT technology.

### Absolute Maximum Ratings <sup>(1)</sup>

| Parameter               | Absolute Maximum | Units |
|-------------------------|------------------|-------|
| RF Input Power          | 20               | dBm   |
| Positive Supply Voltage | +6               | V     |
| Negative Supply Voltage | -6               | V     |
| Control Voltage         | -0.5 to +5.5     | V     |
| Operating Temperature   | -55 to +85       | °C    |
| Storage Temperature     | -65 to +150      | °C    |

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

**Electrical Specifications <sup>(1)</sup> @ T<sub>A</sub> = 25 °C, Z<sub>o</sub> =50 Ω**

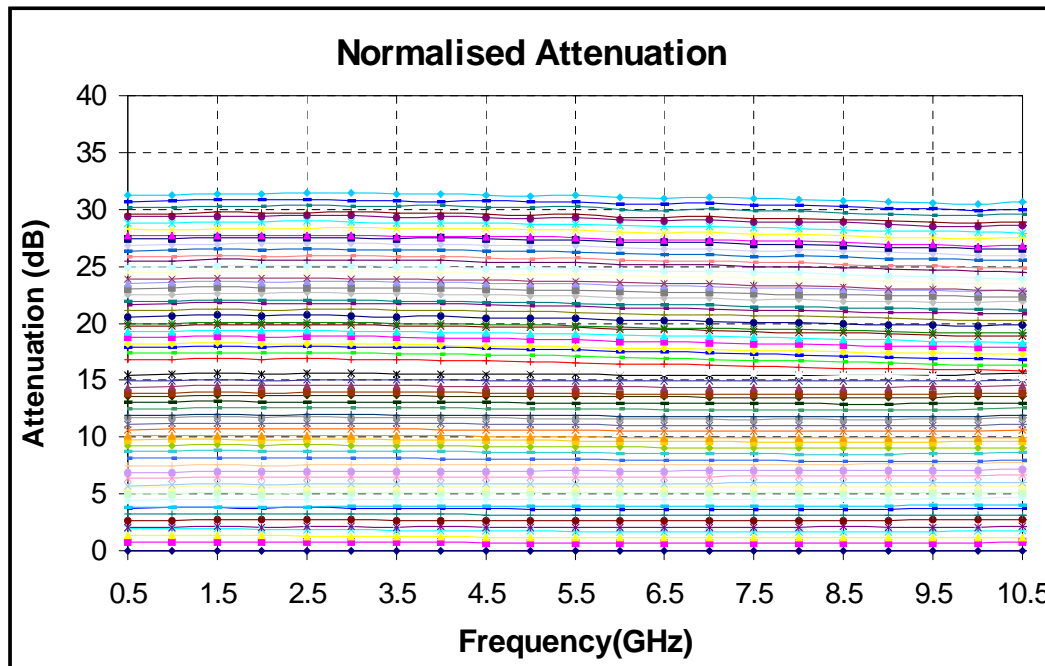
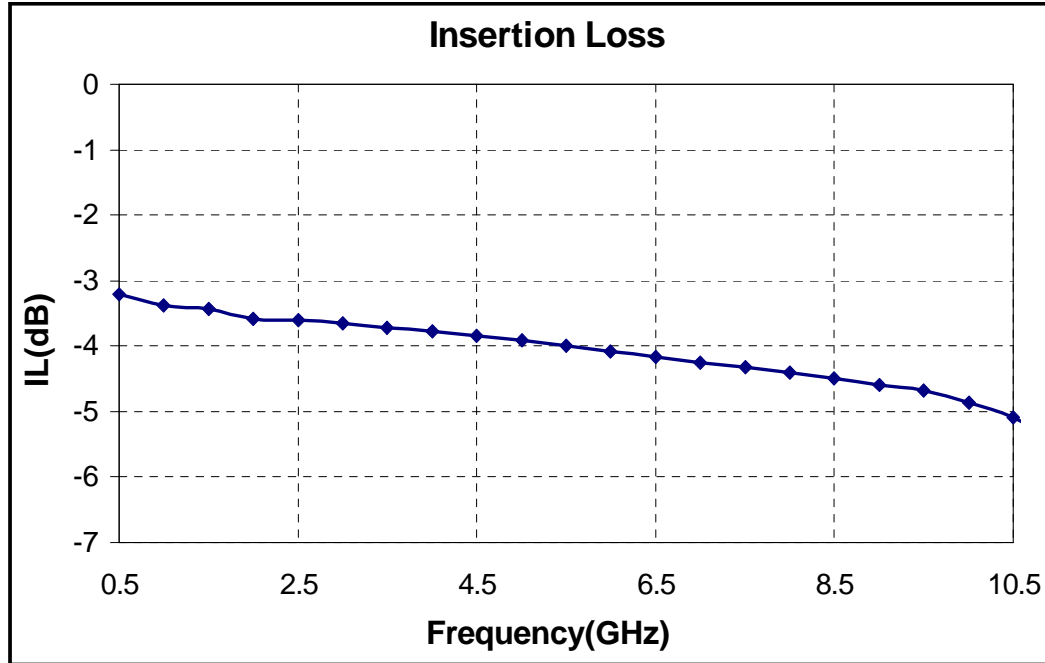
| Parameter                           | Frequency(GHz) | Value                          | Units |
|-------------------------------------|----------------|--------------------------------|-------|
| Attenuation Range                   | 0.5 - 10.5     | 0 - 31.5                       | dB    |
| Attenuation step                    | 0.5 - 10.5     | 0.5                            | dB    |
| Insertion Loss (max)                | 0.5 - 6.0      | 4.0                            | dB    |
|                                     | 6.0 - 10.5     | 5.2                            |       |
| Attenuation Accuracy over 64 states | 0.5 - 6.0      | ± 0.2 +1% of Att. setting max. | dB    |
|                                     | 6.0 - 10.5     | ± 0.4 +3% of Att. setting max. |       |
| Phase variation over 64 states      | 0.5 - 10.5     | 23                             | deg   |
| RMS Error                           | 0.5 - 6.0      | <0.25                          | dB    |
|                                     | 6.0 - 10.5     | < 0.5                          |       |
| Input/Output VSWR                   | 0.5 - 10.5     | 1.6:1                          |       |
| DC Bias Voltages                    | -              | +5, -5                         | V     |
| Control Voltage                     | -              | 0 / +5                         | V     |

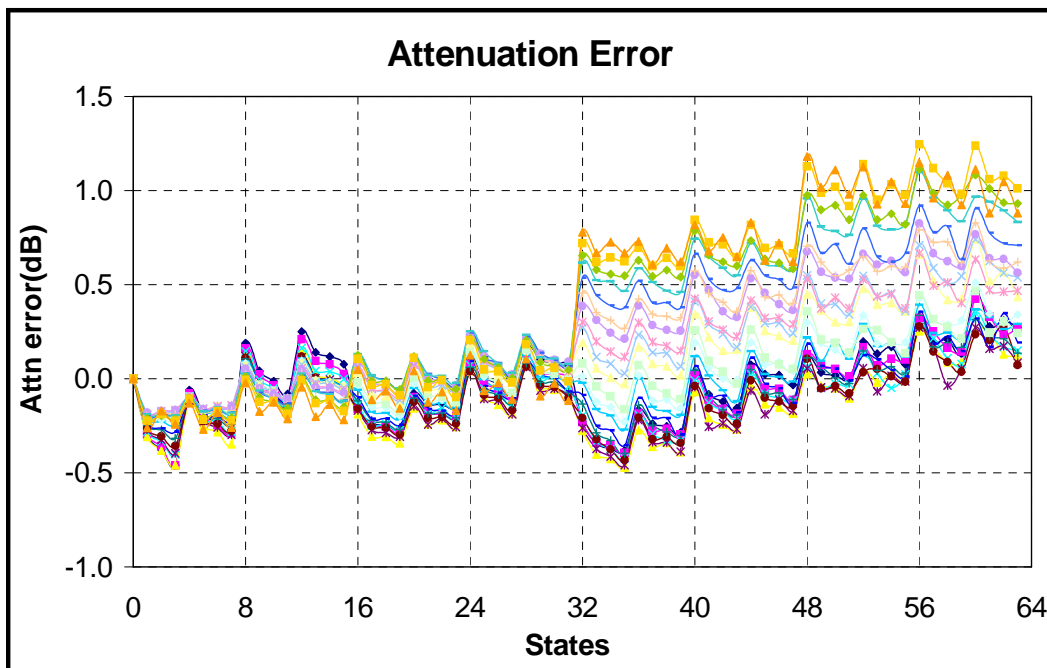
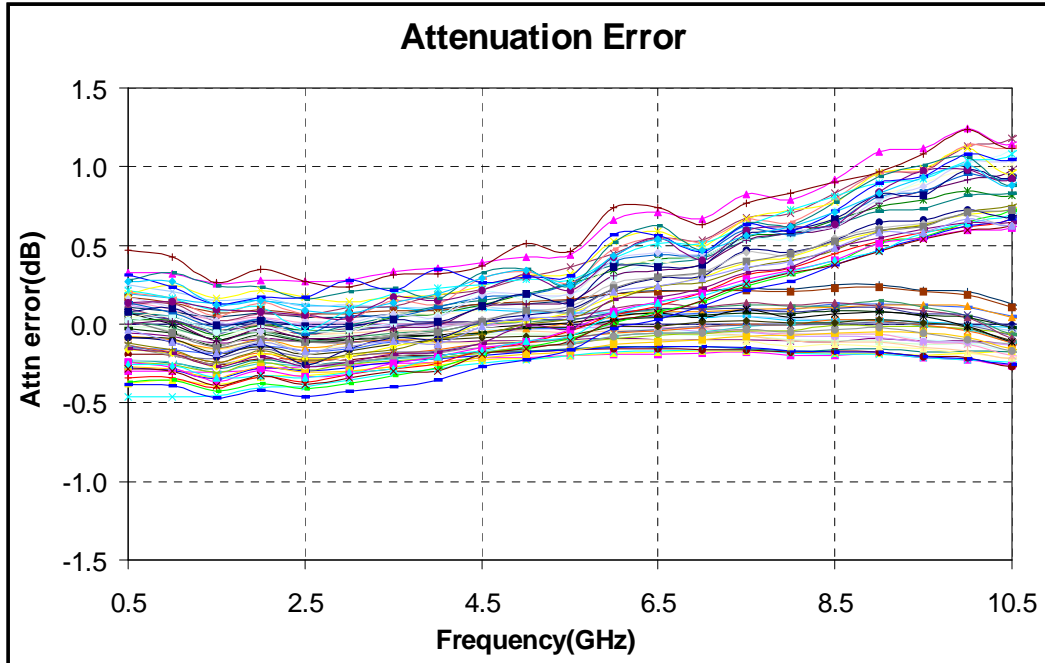
**Note:**

1. Electrical specifications as measured on Wafer.

**On Wafer data**

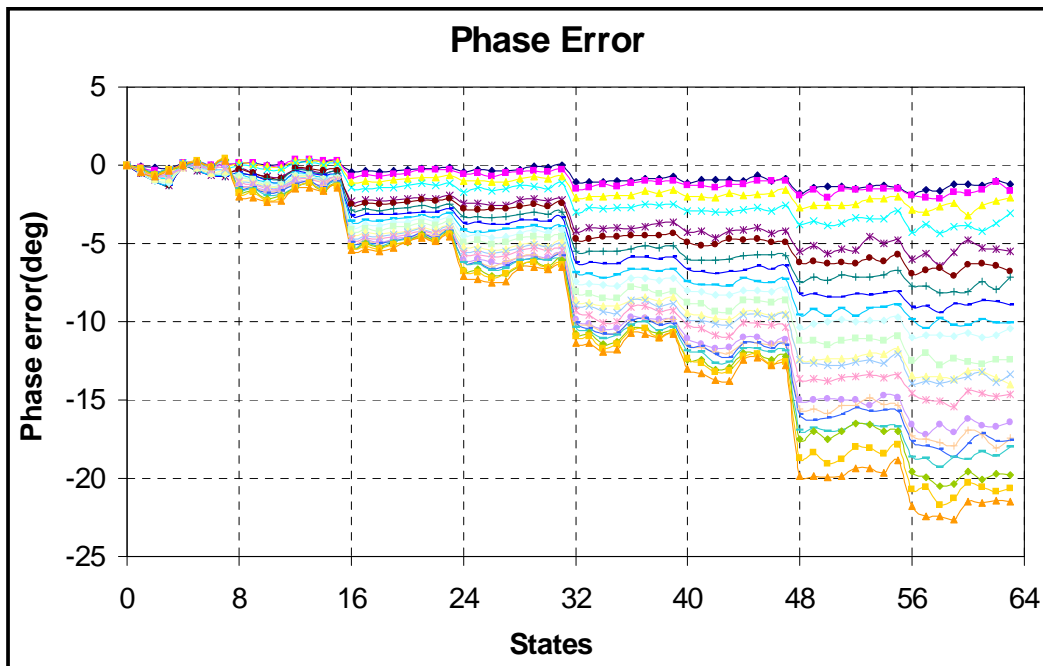
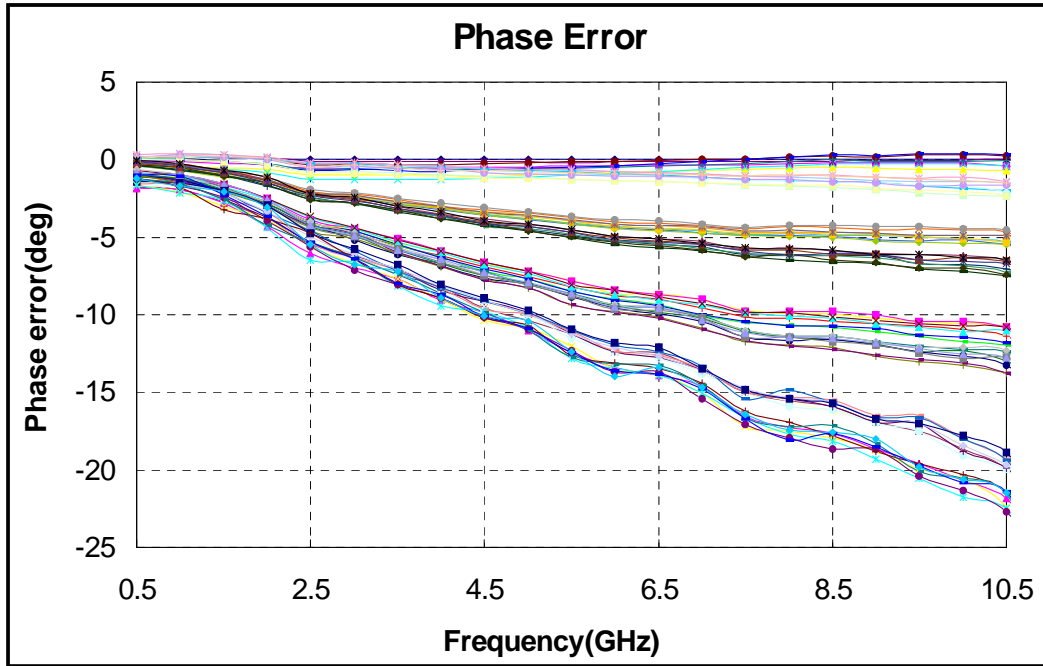
$T_A = 25^\circ\text{C}$

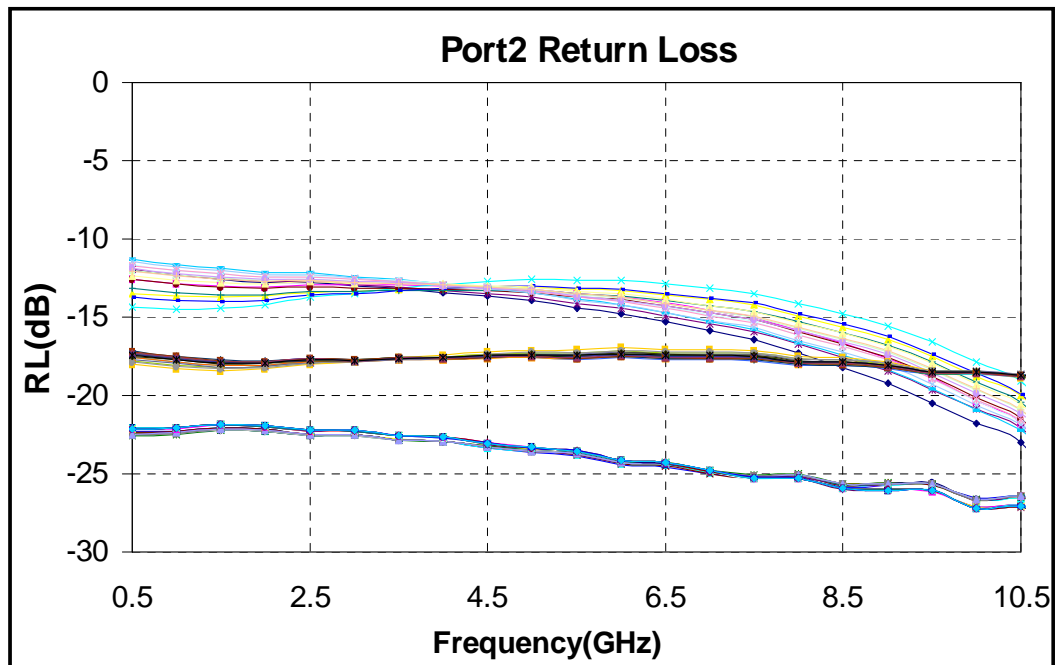
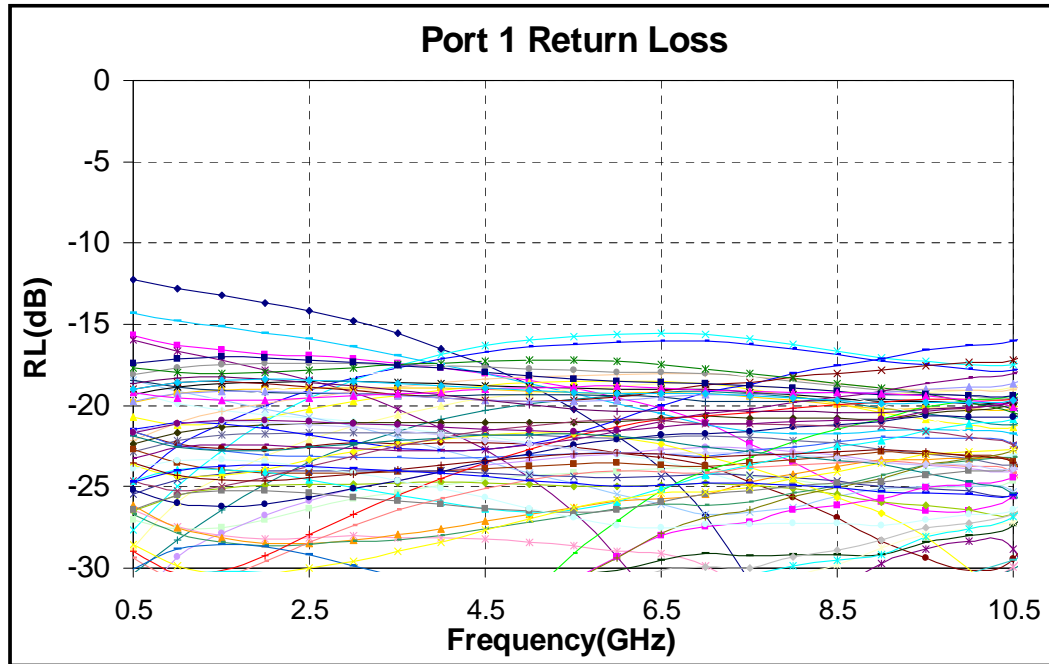


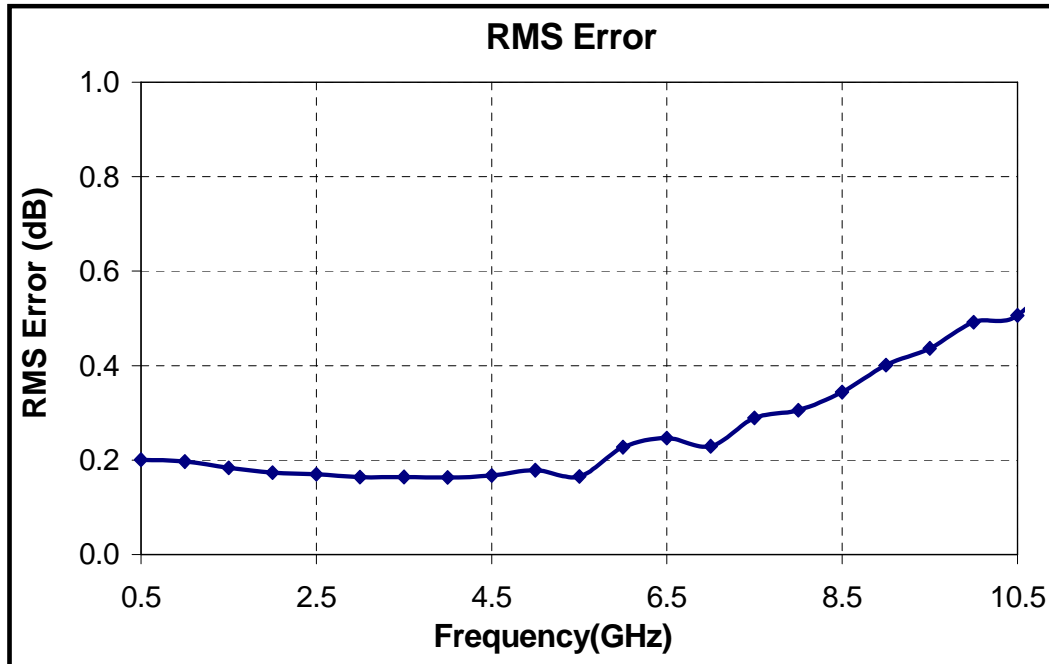
**On Wafer data** $T_A = 25^\circ\text{C}$ 

**On Wafer data**

$T_A = 25^\circ\text{C}$



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**Truth Table**

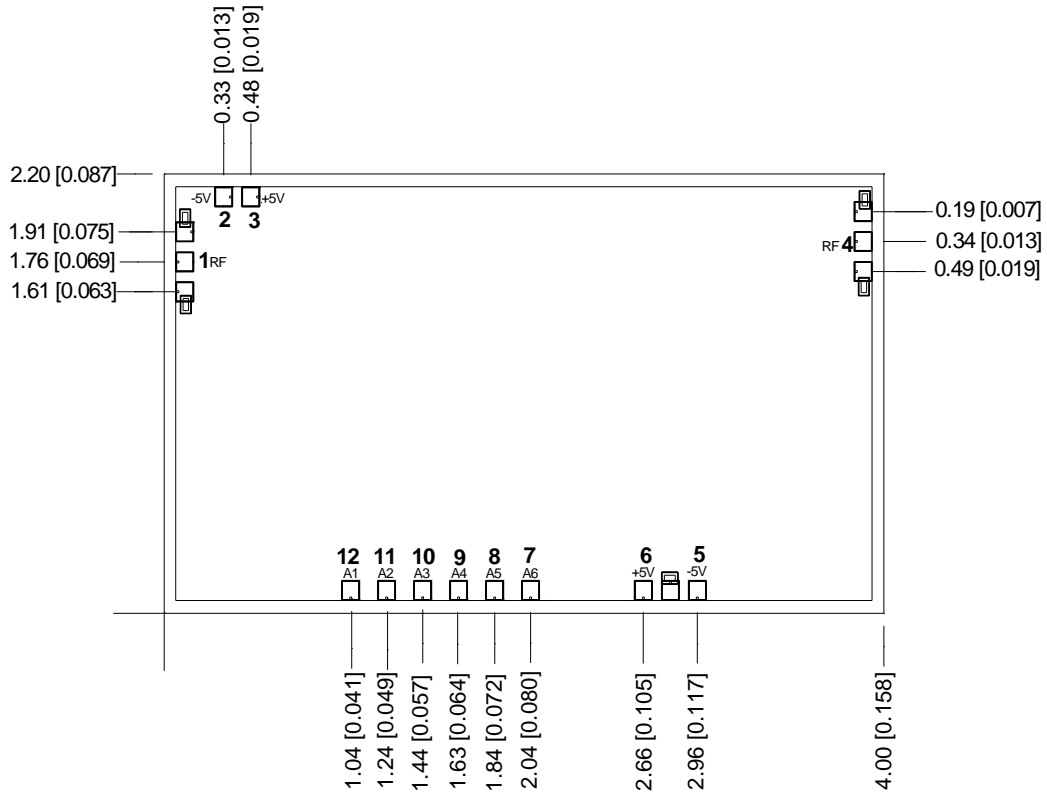
| State | Attenuation (dB) | TTL Control ( 1 = 3.5 to 5 V, 0 = 0 to 0.5 V ) |        |       |        |       |          |
|-------|------------------|--|--------|-------|--------|-------|----------|
|       |                  | A6 (16)  | A5 (8) | A4(4) | A3 (2) | A2(1) | A1 (0.5) |
| 0     | 0                | 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 0.5 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

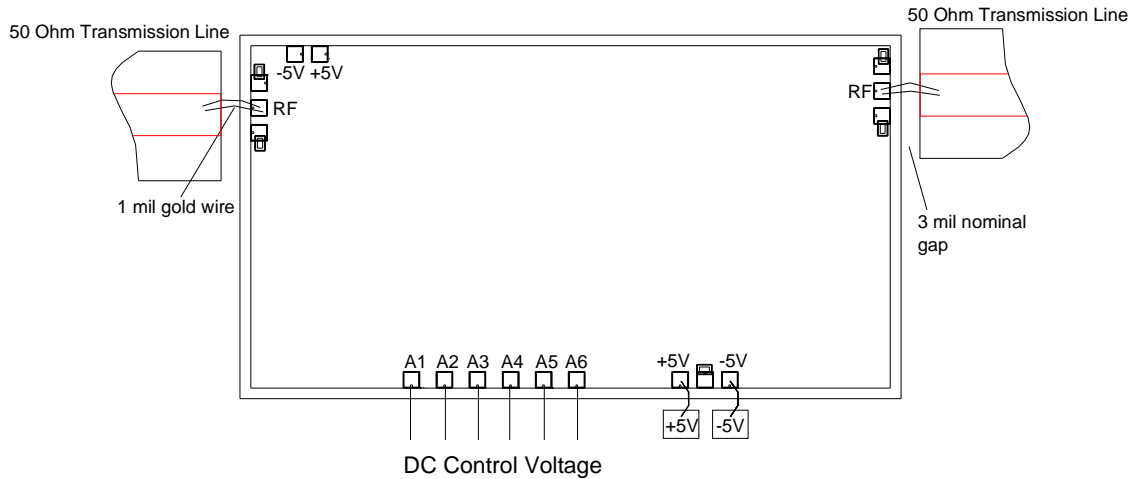


**Units:** millimeters (inches)

**Note:**

1. All RF and DC bond pads are 100µm x 100µm
2. Pad no.1: RF port 1
3. Pad no.2: Optional -5V
4. Pad no.3: Optional +5V
5. Pad no.4: RF port 2
6. Pad no.5: -5V
7. Pad no.6: +5V
8. Pad nos.7-12: Control pads; Pad 7: MSB(16dB) & Pad 12: LSB (0.5dB)

## Recommended Assembly Diagram



### Note:

1. Both the RF ports are DC coupled
2. No external components are required for this chip

**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 - 200 $\mu$ m length of wedge bonds is advised. Single Ball bonds of 250-300 $\mu$ m 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