

# AM2005 – Attenuator

DC to 20 GHz, 31 dB, 5-Bit



## Description

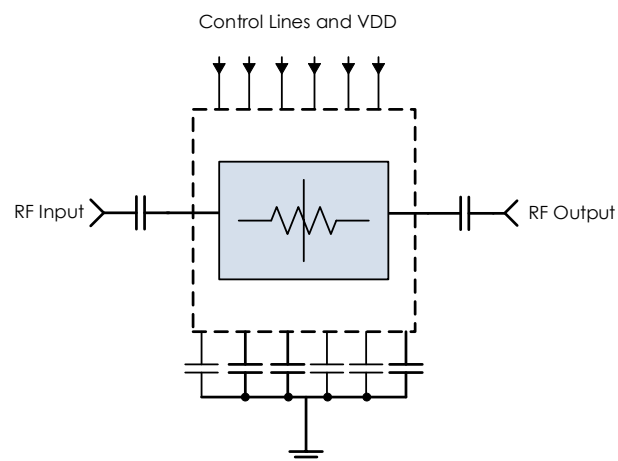
AM2005 is a 31dB 5-Bit digital attenuator covering the DC to 20 GHz frequency range in 1-dB steps. The device provides low insertion loss, flat frequency response, and low attenuation error over the operating temperature range of -40C to +85C.



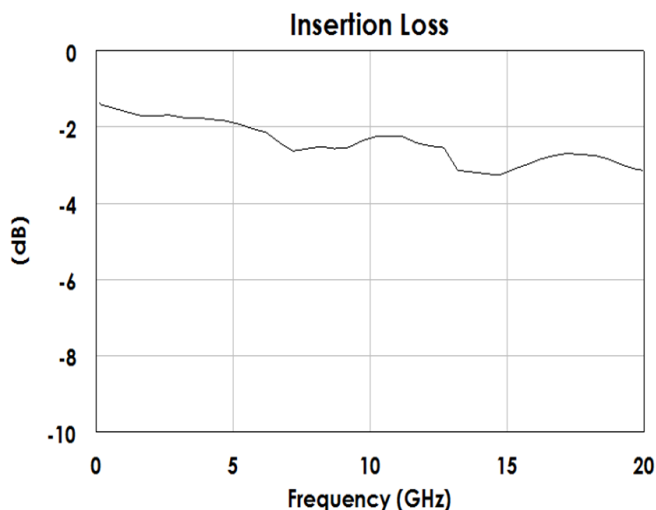
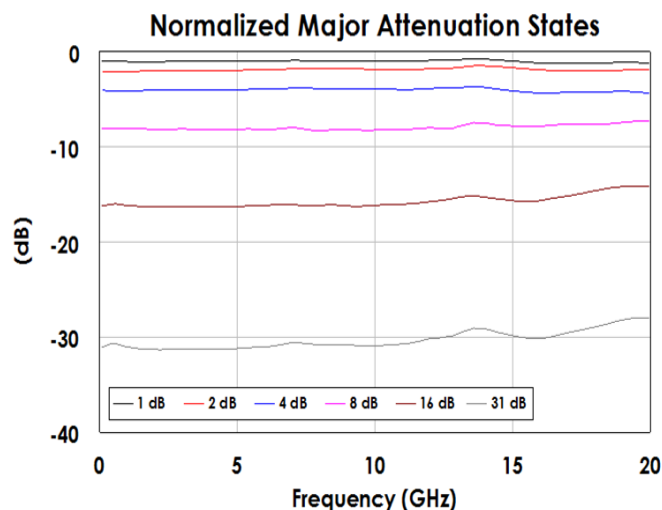
## Features

- 1 dB steps up to 31 dB
- 2.5 dB Insertion Loss
- Integrated Control Line Filtering
- +3.3V or +5V Supply
- +3V or +5V Control
- +40 dBm IP3
- 4mm QFN Package
- -40C to +85C Operation

## Functional Diagram



## Characteristic Performance



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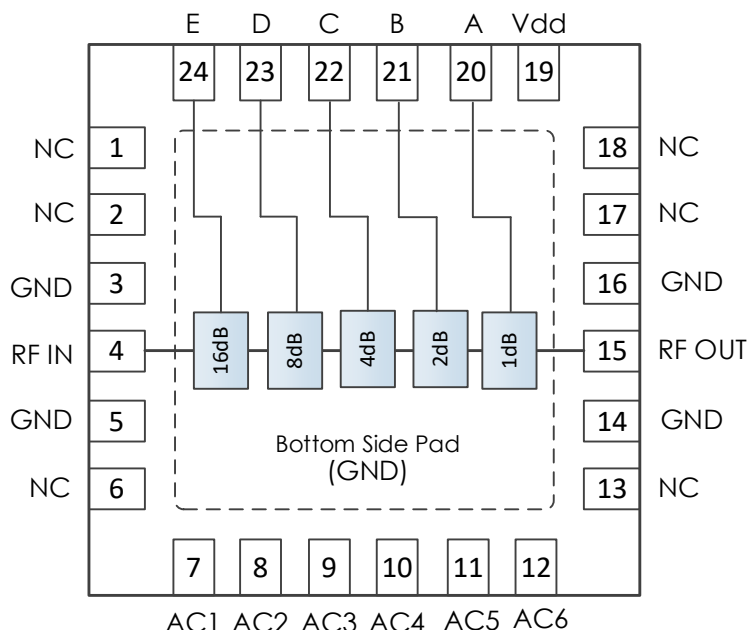
### Revision History

| Date            | Revision Number | Notes                        |
|-----------------|-----------------|------------------------------|
| May 15, 2020    | 6               | Updated Datasheet Format     |
| October 9, 2020 | 7               | Added Attenuation Error Plot |

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## Pin Layout and Definitions



| Pin Number | Pin Name | Pin Function                                                               |
|------------|----------|----------------------------------------------------------------------------|
| 1-2        | NC       | Not Connected*                                                             |
| 3          | GND      | Ground - Common                                                            |
| 4          | RF IN    | RF Input – 50 Ohms – DC Coupled, External DC blocking capacitor required** |
| 5          | GND      | Ground - Common                                                            |
| 6          | NC       | Not Connected                                                              |
| 7          | AC1      | Optional AC ground***                                                      |
| 8          | AC2      | Optional AC ground***                                                      |
| 9          | AC3      | Optional AC ground***                                                      |
| 10         | AC4      | Optional AC ground***                                                      |
| 11         | AC5      | Optional AC ground***                                                      |
| 12         | AC6      | Optional AC ground***                                                      |

### Notes:

\* NC pins may be left open or connected to ground

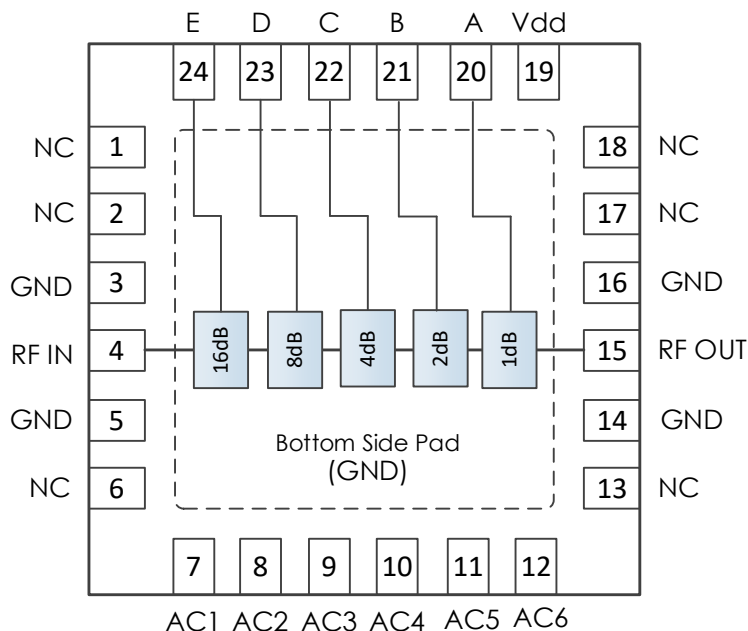
\*\* DC Blocking caps not required if in series with other Atlanta Micro parts of the same reference voltage

\*\*\* AC Ground caps optional. Installing AC ground capacitors offer optimum performance below 400 MHz.

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## Pin Layout and Definitions (continued)



| Pin Number | Pin Name | Pin Function                                                                |
|------------|----------|-----------------------------------------------------------------------------|
| 13         | NC       | No connect*                                                                 |
| 14         | GND      | Ground - Common                                                             |
| 15         | RF OUT   | RF Output – 50 Ohms – DC Coupled, External DC blocking capacitor required** |
| 16         | GND      | Ground - Common                                                             |
| 17-18      | NC       | No Connect                                                                  |
| 19         | Vdd      | DC Power Input                                                              |
| 20         | A        | Attenuator Control Bit A                                                    |
| 21         | B        | Attenuator Control Bit B                                                    |
| 22         | C        | Attenuator Control Bit C                                                    |
| 23         | D        | Attenuator Control Bit D                                                    |
| 24         | E        | Attenuator Control Bit E                                                    |

### Notes:

\* NC pins may be left open or connected to ground

\*\* DC Blocking caps not required if in series with other Atlanta Micro parts of the same reference voltage

## Specifications

### Absolute Maximum Ratings

|                                | Minimum | Maximum |
|--------------------------------|---------|---------|
| Supply Voltage                 | -0.3 V  | 6.0 V   |
| RF Input Power                 |         | +17dBm  |
| Operating Junction Temperature | -40 C   | +150 C  |
| Storage Temperature Range      | -55 C   | +150 C  |

**Note:** Any device operation beyond the Absolute Maximum Ratings may result in permanent damage to the device. The values listed in this table are extremes and do not imply functional operation of the device at these or any other conditions beyond what is listed under Recommended Operating Conditions. Any part subjected to conditions outside of what is recommended for an extended amount of time may suffer from reliability concerns.

### Handling Information

|                                         | Minimum | Maximum |
|-----------------------------------------|---------|---------|
| Storage Temperature Range (Recommended) | -50 C   | +125 C  |
| Moisture Sensitivity Level              | MSL 1   |         |



Atlanta Micro products are electrostatic sensitive.  
Follow safe handling practices to avoid damage

### Recommended Operating Conditions

|                                | Minimum | Typical | Maximum |
|--------------------------------|---------|---------|---------|
| Supply Voltage                 | +3.0 V  | +5.0 V  | +5.2 V  |
| Operating Case Temperature     | -40 C   |         | +85 C   |
| Operating Junction Temperature | -40 C   |         | +125 C  |

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### DC Electrical Characteristics

(T = 25 °C unless otherwise specified)

| Parameter         | Testing Conditions | Minimum | Typical | Maximum |
|-------------------|--------------------|---------|---------|---------|
| DC Supply Voltage |                    | +3.0 V  | +5.0 V  | +5.2 V  |
| DC Supply Current | Vdd = +5.0 V       |         | 3.3 mA  | 4.5 mA  |
| Power Dissipated  | Vdd = +5.0 V       |         | 16.5 mW |         |
| Logic Level Low   |                    | 0.0 V   |         | +0.5 V  |
| Logic Level High  |                    | +2.0 V  |         | +5.0 V  |

### RF Performance

(T = 25 °C unless otherwise specified)

| Parameter       | Testing Conditions | Minimum | Typical | Maximum |
|-----------------|--------------------|---------|---------|---------|
| Frequency Range |                    | DC      |         | 20 GHz  |
| Insertion Loss  | f = 5 GHz          |         | -2 dB   |         |
|                 | f = 15 GHz         |         | -3 dB   |         |
| Return Loss     |                    |         | -15 dB  |         |
| Output IP3      |                    |         | +40 dBm |         |

### Timing Characteristics

| Parameter                       | Minimum | Typical | Maximum |
|---------------------------------|---------|---------|---------|
| 0 dB to 31 dB 50% CTL to 10% RF |         | 100 ns  |         |
| 31 dB to 0 dB 50% CTL to 90% RF |         | 300 ns  |         |
| 50% CTL to RF Envelope Change   |         | 20 ns   |         |

### State Table

| E | D | C | B | A | Attenuation (dB) |
|---|---|---|---|---|------------------|
| L | L | L | L | L | Insertion Loss   |
| L | L | L | L | H | 1                |
| L | L | L | H | L | 2                |
| L | L | H | L | L | 4                |
| L | H | L | L | L | 8                |
| H | L | L | L | L | 16               |
| H | H | H | H | H | 31               |

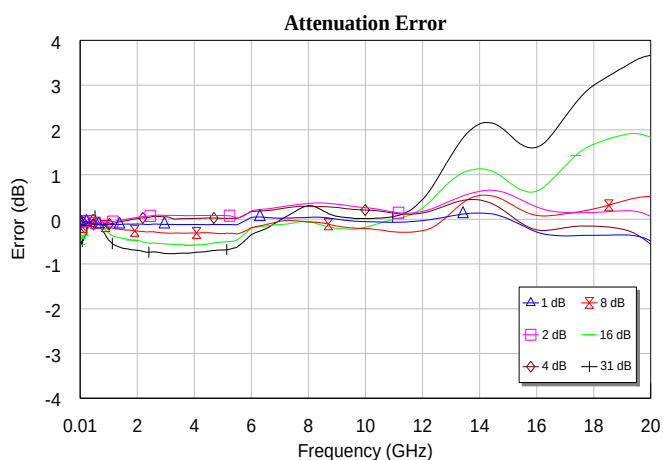
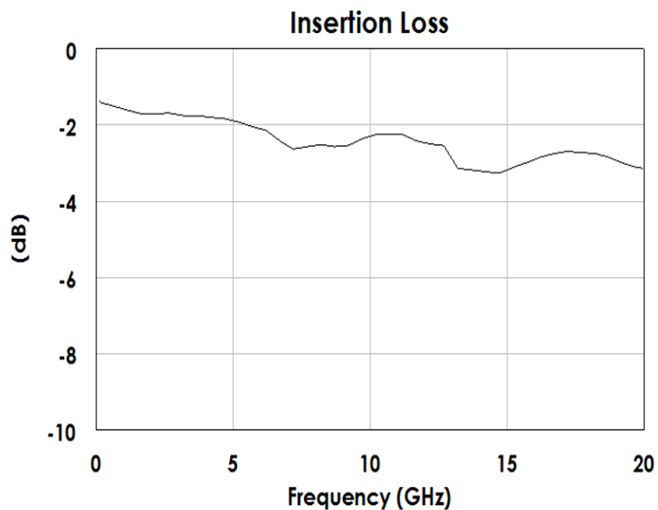
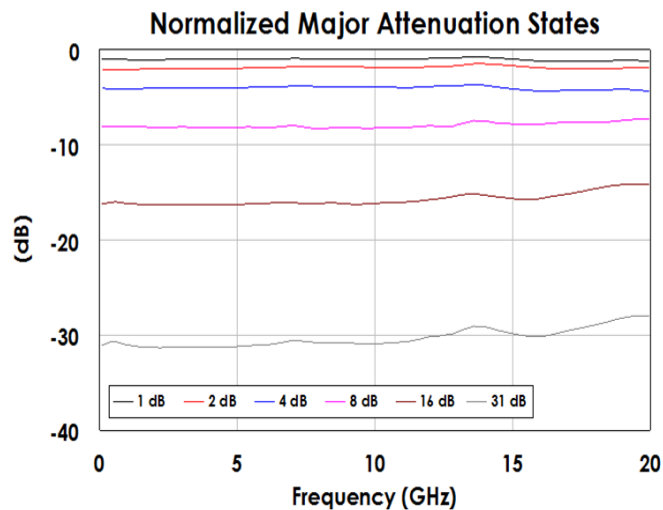
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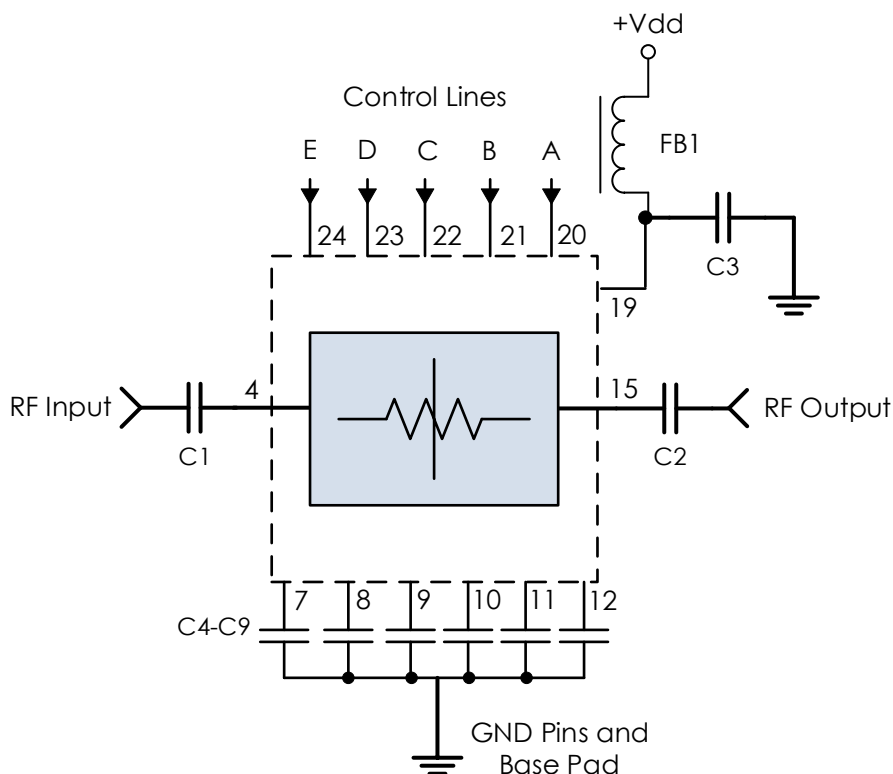
## Typical Performance

(VDD = +3.3V, T = 25°C unless otherwise specified)



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## Typical Application



## Recommended Component List (or equivalent):

| Part    | Value       | Part Number         | Manufacturer  |
|---------|-------------|---------------------|---------------|
| C1, C2  | 0.1 $\mu$ F | 0402BB104KW160      | Passives Plus |
| C3 – C9 | 0.1 $\mu$ F | C1005X7R1H104K050BB | TDK           |
| FB1     | -           | MMZ1005A222E        | TDK           |

## Notes:

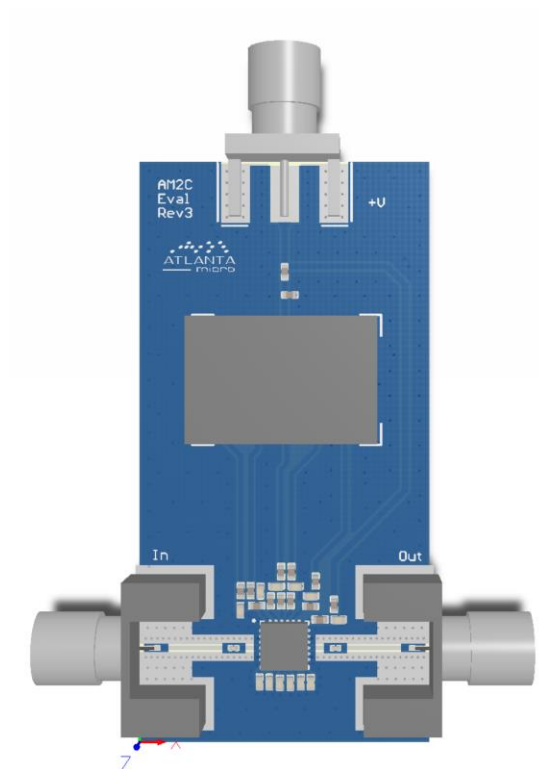
1. DC blocking capacitors should be high performance, low-loss, broadband capacitors for optimum performance.
2. VDD and control lines filtered internally to provide high frequency isolation.
3. C4 through C9 are only required for operation below 400 MHz.



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## Evaluation PC Board



## Related Parts

| Part Number |    | Description |                         |  |
|-------------|----|-------------|-------------------------|--|
| AM2010      | DC | to 30 GHz   | Digital Step Attenuator |  |

### Component Compliance Information

**RoHS:** Atlanta Micro, Inc. hereby certifies that all products comply with the EC Directive 2011/65/EC on the Restriction of Hazardous Substances, commonly known as EU-RoHS 6 and 10. All products supplied by Atlanta Micro shall be compliant with the European Directive 2011/65/EC based on the following substance list.

| Substance List                        | Allowable Maximum Concentration |
|---------------------------------------|---------------------------------|
| Lead (Pb)                             | <1000 PPM (0.1% by weight)      |
| Mercury (Hg)                          | <1000 PPM (0.1% by weight)      |
| Cadmium (Cd)                          | <75 PPM (0.0075% by weight)     |
| Hexavalent Chromium (CrVI)            | <1000 PPM (0.1% by weight)      |
| Polybrominated Biphenyls (PBB)        | <1000 PPM (0.1% by weight)      |
| Polybrominated Diphenyl ethers (PBDE) | <1000 PPM (0.1% by weight)      |
| Decabromodiphenyl Deca BDE            | <1000 PPM (0.1% by weight)      |
| Bis (2-ethylhexyl) Phthalate (DEHP)   | <1000 PPM (0.1% by weight)      |
| Butyl Benzyl Phthalate (BBP)          | <1000 PPM (0.1% by weight)      |
| Dibutyl Phthalate (DBP)               | <1000 PPM (0.1% by weight)      |
| Diisobutyl Phthalate (DIBP)           | <1000 PPM (0.1% by weight)      |

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