

## Digital Attenuator 31.5 dB, 6-Bit, TTL Driver, DC-2.0 GHz

Rev. V7

### Features

- Attenuation: 0.5 dB Steps to 31.5 dB<sup>1</sup>
- Temperature Stability:  $\pm 0.18$  dB from  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  Typ.
- Low DC Power Consumption
- Surface Mount Package
- Integral TTL Driver
- High Intercept Point
- Low Cost/High Performance
- Lead-Free CR-13 Package
- $260^{\circ}\text{C}$  Reflow Compatible
- RoHS\* Compliant

### Description

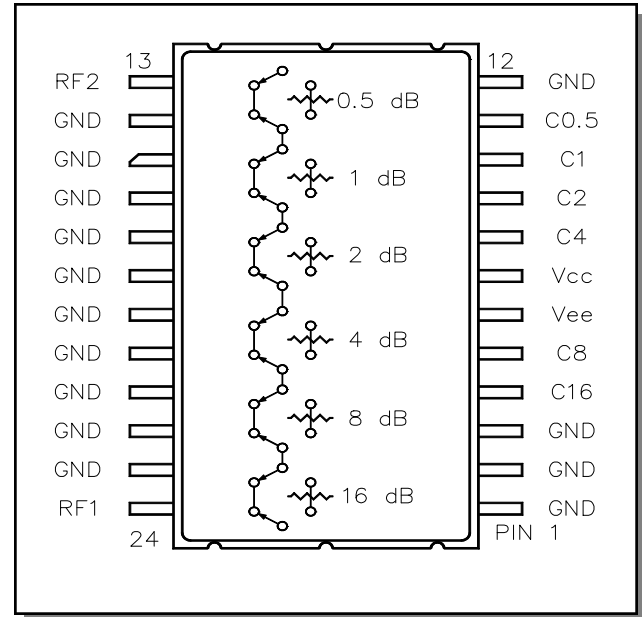
M/A-COM's AT20-0107 is a GaAs FET 6-bit digital attenuator with a 0.5 dB minimum step size and a 31.5 dB total attenuation. This attenuator and integral TTL driver is in a ceramic 24-lead surface mount package. The AT20-0107 is ideally suited for use where accuracy, fast speed, very low power consumption and low intermodulation products are required. Typical applications include dynamic range setting in precision receiver circuits and other gain/leveling control circuits. Available with enhanced performance as fully hermetic version. Environmentally screenable as P/N AT-107-PIN.

### Ordering Information

| Part Number   | Package           |
|---------------|-------------------|
| AT20-0107-PIN | Bulk Packaging    |
| AT20-0107-TR  | 1000 piece reel   |
| AT20-0107-TB  | Sample Test Board |

Note: Reference Application Note M513 for reel size information.

### Functional Schematic



### Pin Configuration

| Pin No. | Function | Pin No. | Function |
|---------|----------|---------|----------|
| 1       | GND      | 13      | RF2      |
| 2       | GND      | 14      | GND      |
| 3       | GND      | 15      | GND      |
| 4       | C16      | 16      | GND      |
| 5       | C8       | 17      | GND      |
| 6       | Vee      | 18      | GND      |
| 7       | Vcc      | 19      | GND      |
| 8       | C4       | 20      | GND      |
| 9       | C2       | 21      | GND      |
| 10      | C1       | 22      | GND      |
| 11      | C0.5     | 23      | GND      |
| 12      | GND      | 24      | RF1      |

The metal bottom of the case must be connected to RF and DC ground.

\* Restrictions on Hazardous Substances, European Union Directive 2002/95/EC.

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**Electrical Specifications:  $T_A = +25^\circ\text{C}^2$** 

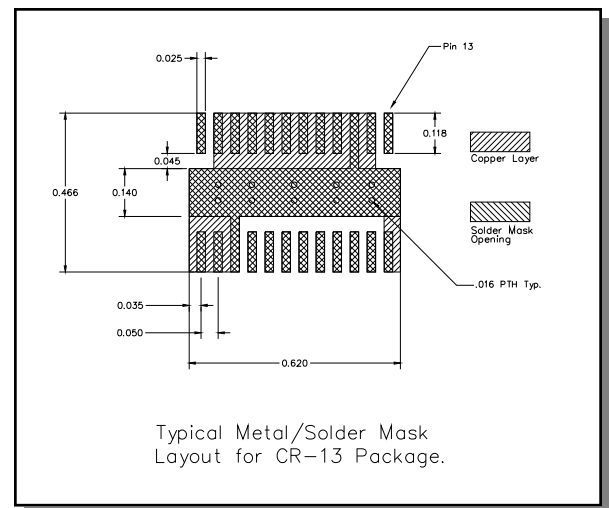
| Parameter                               | Test Conditions                                                      | Frequency               | Units          | Min         | Typ             | Max                                        |
|-----------------------------------------|----------------------------------------------------------------------|-------------------------|----------------|-------------|-----------------|--------------------------------------------|
| Insertion Loss                          | —                                                                    | DC - 2.0 GHz            | dB             | —           | 3.2             | 3.8                                        |
| Attenuation Accuracy <sup>1,3,4</sup>   | Any Bit or Combination of Bits                                       | DC - 2.0 GHz            | dB             | —           | —               | +.3 +7% of atten.)<br>- (.2 +1% of atten.) |
| VSWR                                    | Full Range                                                           | DC - 2.0 GHz            | Ratio          | —           | —               | 1.8:1                                      |
| Trise, Tfall<br>Ton, Toff<br>Transients | 10% to 90%<br>50% Control to 90%/10%<br>RF<br>In-band (peak to peak) | —<br>—<br>—             | ns<br>ns<br>mV | —<br>—<br>— | 50<br>150<br>50 | —<br>—<br>—                                |
| 1 dB Compression <sup>5</sup>           | Input Power<br>Input Power                                           | 50 MHz<br>0.5 - 2.0 GHz | dBm<br>dBm     | —<br>—      | +21<br>+29      | —<br>—                                     |
| Input IP <sub>3</sub> <sup>5</sup>      | Two Tone Inputs up to<br>+5 dBm                                      | 50 MHz<br>0.5 - 2.0 GHz | dBm<br>dBm     | —<br>—      | +35<br>+48      | —<br>—                                     |
| Input IP <sub>2</sub> <sup>5</sup>      | Two Tone Inputs up to<br>+5 dBm                                      | 50 MHz<br>0.5 - 2.0 GHz | dBm<br>dBm     | —<br>—      | +45<br>+79      | —<br>—                                     |
| V <sub>CC</sub><br>-V <sub>EE</sub>     | —<br>—                                                               | —<br>—                  | V<br>V         | 4.5<br>-8.0 | 5.0<br>—        | 5.5<br>-5.0                                |
| I <sub>CC</sub>                         | V <sub>CC</sub> = 4.5 to 5.5V                                        | —                       | mA             | —           | —               | 6.0                                        |
| -I <sub>EE</sub>                        | -V <sub>EE</sub> = -5.0 to -8.0V                                     | —                       | mA             | —           | —               | 1.0                                        |

- Above reference insertion loss.
- All specifications apply when operated with bias voltages of +5V for V<sub>CC</sub> and -5.0 V to -8.0 V for V<sub>EE</sub> and 50Ω impedance at all ports unless otherwise stated.
- This attenuator is guaranteed monotonic.
- For the attenuator to meet the guaranteed specifications, it is necessary to have a DC return on either RF1 or RF2. The DC return can be either a 10KΩ resistor, or an RF choke.
- V<sub>EE</sub> = -5 V for the typical numbers given.

**Absolute Maximum Ratings<sup>6,7</sup>**

| Parameter                                     | Absolute Maximum                                  |
|-----------------------------------------------|---------------------------------------------------|
| Max. Input Power<br>0.05 GHz<br>0.5 - 2.0 GHz | +27 dBm<br>+34 dBm                                |
| V <sub>CC</sub>                               | -0.5V ≤ V <sub>CC</sub> ≤ +7.0V                   |
| V <sub>EE</sub>                               | -8.5V ≤ V <sub>EE</sub> ≤ +0.5V                   |
| V <sub>CC</sub> - V <sub>EE</sub>             | -0.5V ≤ V <sub>CC</sub> - V <sub>EE</sub> ≤ 14.5V |
| V <sub>in</sub> <sup>8</sup>                  | -0.5V ≤ V <sub>in</sub> ≤ V <sub>CC</sub> + 0.5V  |
| Operating Temperature                         | -40°C to +125°C                                   |
| Storage Temperature                           | -65°C to +150°C                                   |

- Exceeding any one or combination of these limits may cause permanent damage to this device.
- M/A-COM does not recommend sustained operation near these survivability limits.
- Standard CMOS TTL interface, latch-up will occur if logic signal is applied prior to power supply.

**Recommended PCB Configuration**


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### Handling Procedures

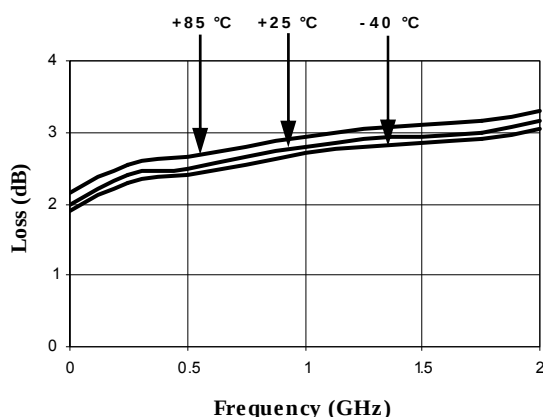
Please observe the following precautions to avoid damage:

### Static Sensitivity

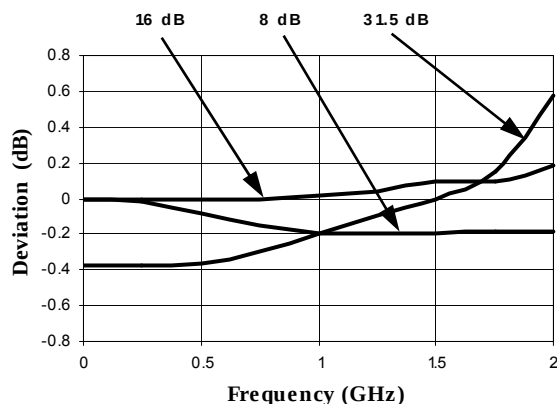
Gallium Arsenide Integrated Circuits are sensitive to electrostatic discharge (ESD) and can be damaged by static electricity. Proper ESD control techniques should be used when handling these devices.

### Typical Performance Curves

#### Insertion Loss vs. Frequency



#### Attenuation Accuracy vs. Frequency

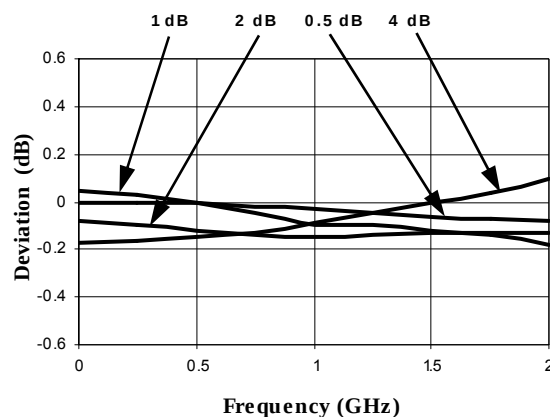


### Truth Table (Digital Attenuator)

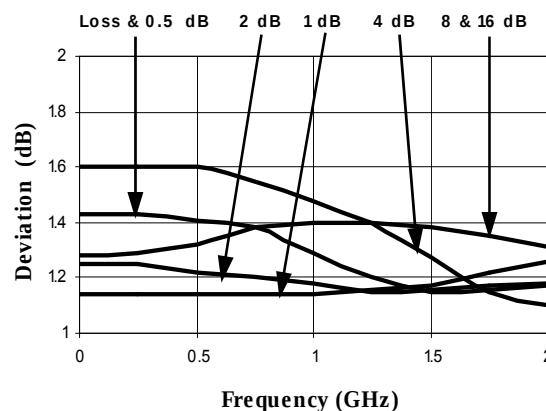
| C16 | C8 | C4 | C2 | C1 | C0.5 | Attenuation     |
|-----|----|----|----|----|------|-----------------|
| 0   | 0  | 0  | 0  | 0  | 0    | Loss, Reference |
| 0   | 0  | 0  | 0  | 0  | 1    | 0.5 dB          |
| 0   | 0  | 0  | 0  | 1  | 0    | 1.0 dB          |
| 0   | 0  | 0  | 1  | 0  | 0    | 2.0 dB          |
| 0   | 0  | 1  | 0  | 0  | 0    | 4.0 dB          |
| 0   | 1  | 0  | 0  | 0  | 0    | 8.0 dB          |
| 1   | 0  | 0  | 0  | 0  | 0    | 16.0 dB         |
| 1   | 1  | 1  | 1  | 1  | 1    | 31.5 dB         |

0 = TTL Low; 1 = TTL High

#### Attenuation Accuracy vs. Frequency



#### RF1 VSWR vs. Frequency

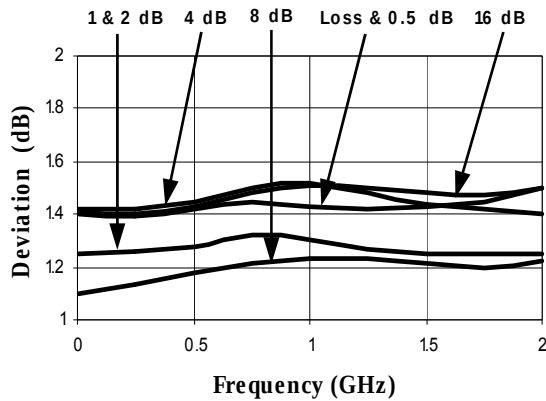


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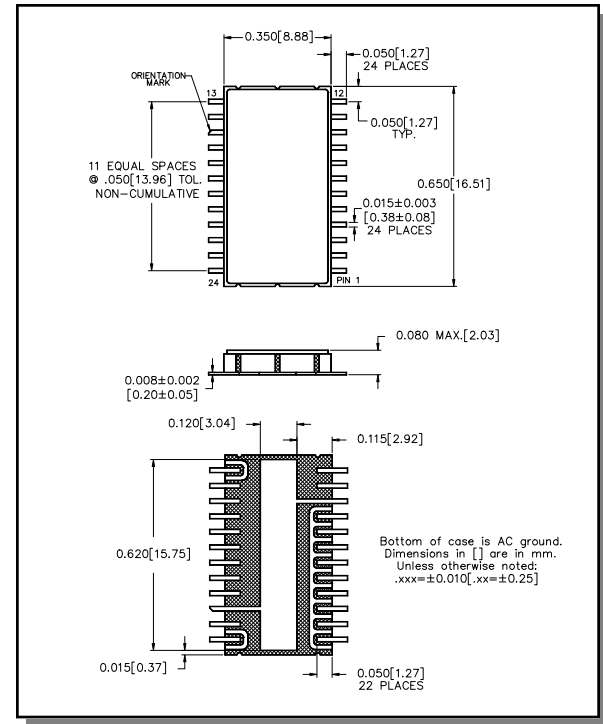
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### Typical Performance Curves

RF2 VSWR vs. Frequency



### Lead-Free, CR-13 Ceramic Package<sup>†</sup>



<sup>†</sup> Reference Application Note M538 for lead-free solder reflow recommendations.