

**DATA SHEET**

# AA103-72/-72LF: 10 MHz - 2.5 GHz GaAs One-Bit Digital Attenuator (10 dB LSB)

**Applications**

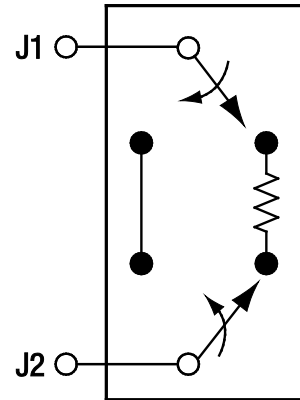
- Cellular radio
- Wireless data systems
- WLL gain level control circuits

**Features**

- Attenuation: 10 dB
- Single, positive control voltage: 3 V
- Low loss
- Small SOT-5 package (MSL1, 260 °C per JEDEC J-STD-020)

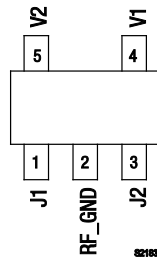


Skyworks offers lead (Pb)-free, RoHS (Restriction of Hazardous Substances)-compliant packaging.



S2351

**Figure 1. AA103-72/-72LF Block Diagram**



**Figure 2. AA103-72/-72LF Pinout – 5-Pin SOT-5 (Top View)**

**Description**

The AA103-72/-72LF are one-bit GaAs FET digital attenuators in a low-cost SOT-5 package. These devices provide an LSB of 10 dB.

The AA103-72/-72LF are particularly suited where high attenuation accuracy, low insertion loss, and low intermodulation products are required.

A functional block diagram is shown in Figure 1. The pin configuration and package are shown in Figure 2. Signal pin assignments and functional pin descriptions are provided in Table 1.

**Table 1. AA103-72/-72LF Signal Descriptions**

| Pin # | Name   | Description                              | Pin # | Name | Description     |
|-------|--------|--|-------|------|-----------------|
| 1     | J1     | RF port. Must be DC blocked.             | 4     | V1   | DC control bias |
| 2     | RF_GND | RF ground. Must be AC-coupled to ground. | 5     | V2   | DC control bias |
| 3     | J2     | RF port. Must be DC blocked.             |       |      |                 |

**Table 2. AA103-72/-72LF Absolute Maximum Ratings**

| Parameter             | Symbol           | Minimum | Maximum                                     | Units      |
|-----------------------|------------------|---------|---|------------|
| RF input power        | P <sub>IN</sub>  |         | 1 W > 500 MHz 0/8 V<br>0.5 W @ 50 MHz 0/8 V | dBm<br>dBm |
| Supply voltage        | V <sub>S</sub>   |         | 8   | V          |
| Control voltage       | V <sub>CTL</sub> | -0.2    | +8.0  | V          |
| Operating temperature | T <sub>OP</sub>  | -40     | +85   | °C         |
| Storage temperature   | T <sub>STG</sub> | -65     | +150  | °C         |

**Note:** Exposure to maximum rating conditions for extended periods may reduce device reliability. There is no damage to device with only one parameter set at the limit and all other parameters set at or below their nominal value. Exceeding any of the limits listed here may result in permanent damage to the device.

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**CAUTION:** Although this device is designed to be as robust as possible, Electrostatic Discharge (ESD) can damage this device. This device must be protected at all times from ESD. Static charges may easily produce potentials of several kilovolts on the human body or equipment, which can discharge without detection. Industry-standard ESD precautions should be used at all times.

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**Electrical and Mechanical Specifications**

The absolute maximum ratings of the AA103-72/-72LF are provided in Table 2. Electrical specifications are provided in Tables 3.

Typical performance characteristics of the AA103-72/-72LF are illustrated in Figures 3 through 5.

The state of the AA103-72/-72LF is determined by the logic provided in Table 4.

**Table 3. AA103-72/-72LF Electrical Specifications (Note 1)**  
**(V<sub>CTL</sub> = 0/3 V Characteristic Impedance [Z<sub>0</sub>] = 50 Ω, Unless Otherwise Noted)**

| Parameter  | Symbol           | Test Condition (Note 2)   | Min                                  | Typical | Max                         | Units  |
|--|------------------|---|--------------------------------------|---------|-----------------------------|--------|
| Insertion loss (Note 2)                                  | IL               | 10 MHz to 0.5 GHz   |                                      | 0.3     | 0.5                         | dB     |
|  |                  | 0.5 GHz to 1.0 GHz  |                                      | 0.3     | 0.6                         | dB     |
|  |                  | 1.0 GHz to 2.5 GHz  |                                      | 0.4     | 0.7                         | dB     |
| Attenuation range  |                  |   |                                      | 10      |                             | dB     |
| Attenuation accuracy (Note 3)                            |                  | 10 MHz to 1.0 GHz   | ± (0.25 + 3% of attenuation setting) |         |                             | dB     |
|  |                  | 1.0 GHz to 2.5 GHz  | ± (0.4 + 5% of attenuation setting)  |         |                             | dB     |
| Voltage Standing Wave Ratio (I/O)                        | VSWR             | 10 MHz to 2.5 GHz   |                                      | 1.2:1   | 1.4:1                       | –      |
| Voltage Standing Wave Ratio (attenuation state) (Note 4) | VSWR             | 0.01 GHz to 2.5 GHz   |                                      | 1.5:1   | 2.0:1                       | –      |
| Switching characteristics (Note 4):                      |                  | 10/90% or 90/10% RF<br>50% V <sub>CTL</sub> to 90/10% RF<br>T <sub>RISE</sub> = 1 ns,<br>bandwidth = 500 MHz              |                                      | 150     |                             | ns     |
|  |                  |   |                                      | 300     |                             | ns     |
|  |                  |   |                                      | 70      |                             | mV     |
| 1 dB Input Compression Point                             | IP1dB            | 0.5 to 2.5 GHz:<br>V <sub>S</sub> = 3 V,<br>V <sub>S</sub> = 5 V  |                                      | +20     |                             | dBm    |
|  |                  |   |                                      | +26     |                             | dBm    |
| 3 <sup>rd</sup> Order Input Intercept Point              | IIP3             | For two-tone input,<br>P <sub>IN</sub> = +10 dBm/tone,<br>0.5 to 2.5 GHz:<br>V <sub>S</sub> = 3 V<br>V <sub>S</sub> = 5 V |                                      | +41     |                             | dBm    |
|  |                  |   |                                      | +45     |                             | dBm    |
| Control voltages   | V <sub>CTL</sub> | V <sub>CTL</sub> = V <sub>LOW</sub><br>V <sub>CTL</sub> = V <sub>HIGH</sub>   | 0<br>3 @ 25 μA<br>typical to 5 V     |         | 0.2<br>5 @ 50 μA<br>typical | V<br>V |

**Note 1:** Performance is guaranteed only under the conditions listed in this Table.

**Note 2:** Insertion loss changes by 0.003 dB/ °C.

**Note 3:** Maximum attenuation includes insertion loss.

**Note 4:** Switching characteristics vary with value chosen for bypass capacitor.

**Table 4. AA103-72/-72LF Truth Table**

| J1 to J2       | V1<br>(Pin 4)     | V2<br>(Pin 6)     |
|----------------|-------------------|-------------------|
| Insertion loss | V <sub>HIGH</sub> | 0                 |
| Attenuation    | 0                 | V <sub>HIGH</sub> |

**Note:** V<sub>HIGH</sub> = +3 V to +5 V (V<sub>S</sub> = V<sub>HIGH</sub> ± 0.2 V).  
 All other conditions not recommended.

### Typical Performance Characteristics

( $V_{CTL} = 0/3\text{ V}$  Characteristic Impedance [ $Z_0$ ] =  $50\ \Omega$ , Unless Otherwise Noted)

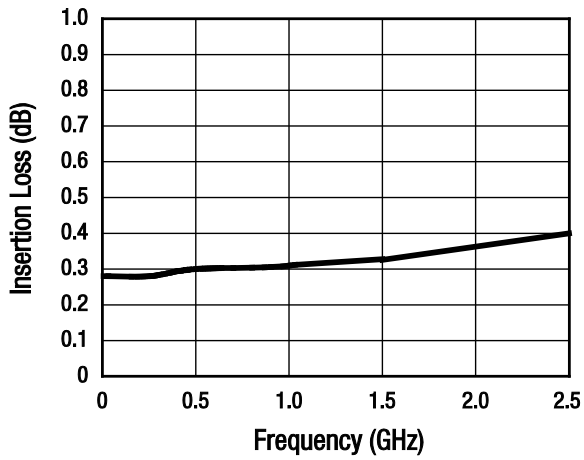


Figure 3. Insertion Loss vs Frequency

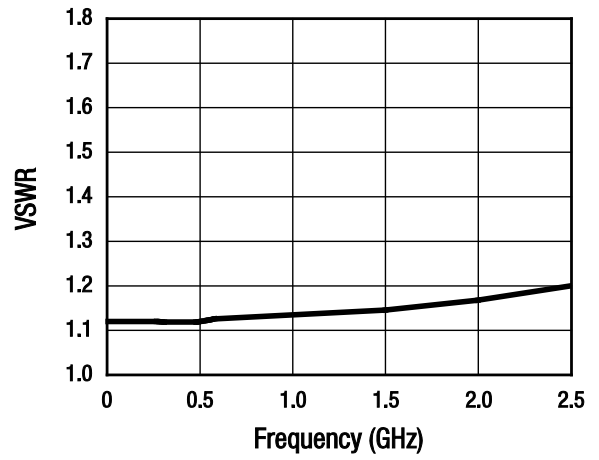


Figure 4. VSWR vs Frequency

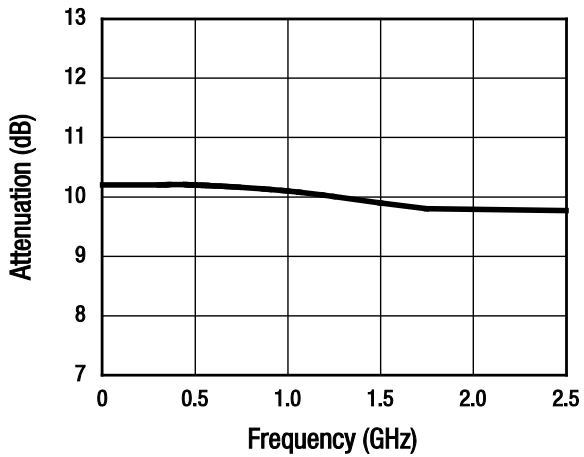


Figure 5. Attenuation vs Frequency

### Evaluation Board Description

The AA103-72/-72LF Evaluation Board is used to test the performance of the AA103-72/-72LF digital attenuator. An Evaluation Board schematic diagram is shown in Figure 6.

### Package Dimensions

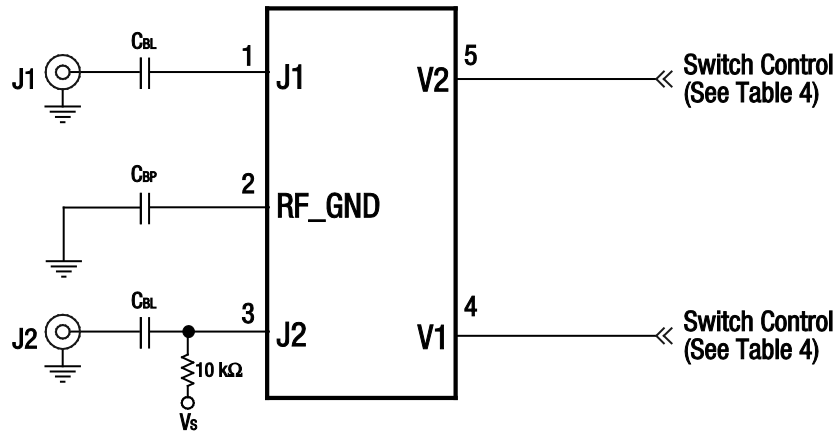
Package dimensions for the 5-pin SOT-5 are shown in Figure 7, and tape and reel dimensions are provided in Figure 8.

### Package and Handling Information

Instructions on the shipping container label regarding exposure to moisture after the container seal is broken must be followed. Otherwise, problems related to moisture absorption may occur when the part is subjected to high temperature during solder assembly.

THE AA103-72/-72LF is rated to Moisture Sensitivity Level 1 (MSL1) at 260 °C. It can be used for lead or lead-free soldering. For additional information, refer to the Skyworks Application Note, *Solder Reflow Information*, document number 200164.

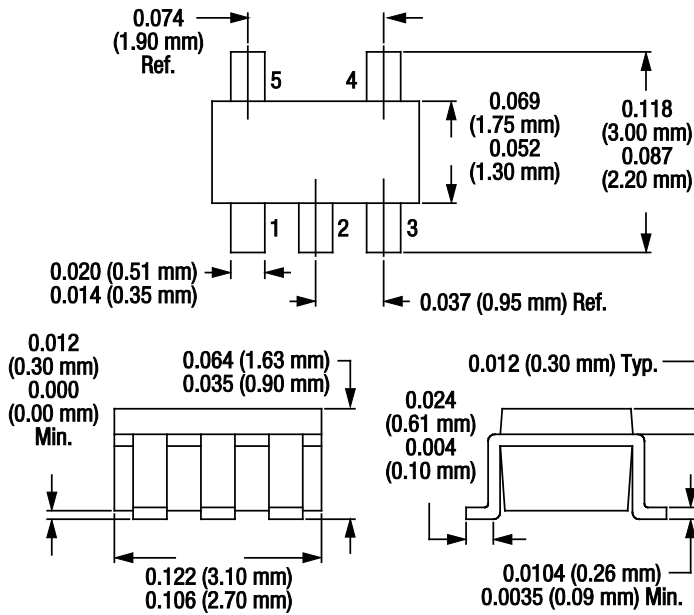
Care must be taken when attaching this product, whether it is done manually or in a production solder reflow environment. Production quantities of this product are shipped in a standard tape and reel format.



*Note: DC blocking capacitors (CBL), bypass capacitor (CBP), and biasing resistor must be supplied externally for positive voltage operation.  
CBL = 33 pF, CBP = 33 pF for 900 MHz operation.*

S2366

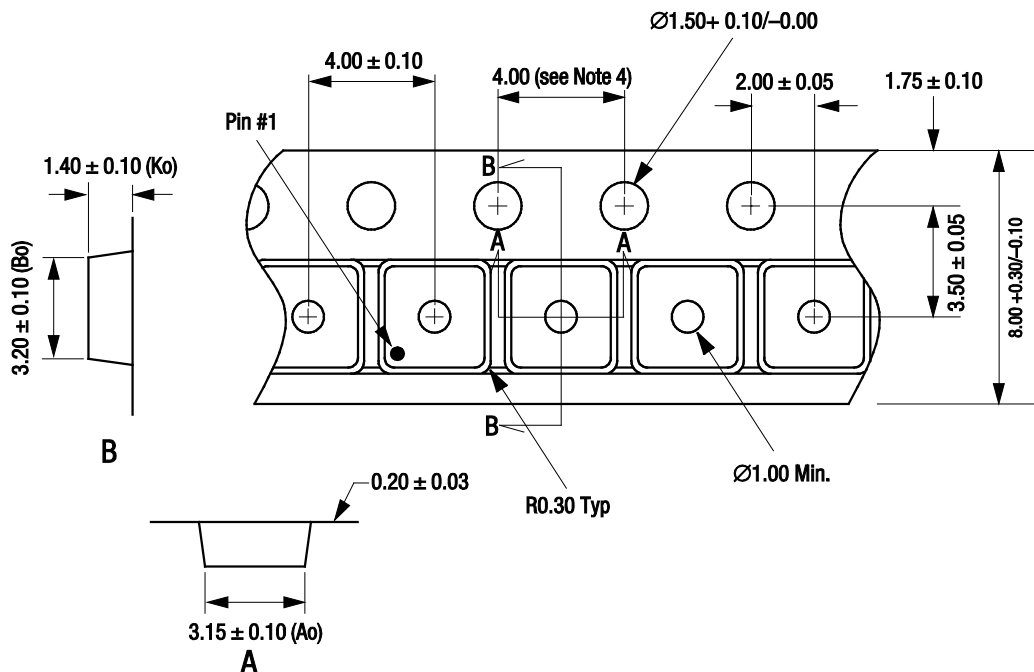
**Figure 6. AA103-72/-72LF Evaluation Board Schematic Diagram**



Dimensions are in inches (millimeters shown in parentheses)

S1657

Figure 7. AA103-72/-72LF 5-Pin SOT-5 Package Dimensions



- Notes:
1. Carrier tape: black conductive polystyrene.
  2. Cover tape material: transparent conductive HSA.
  3. Cover tape size: 5.40 mm width.
  4. Ten sprocket hole pitch cumulative tolerance = ±0.20 mm.
  5. All measurements are in millimeters.
  6. Standard reel size is 7 inches. Standard reel quantity is 3000 pcs.

S1681

Figure 8. AA103-72/-72LF Tape and Reel Dimensions

## Ordering Information

| Model Name                                | Manufacturing Part Number | Evaluation Board Part Numbers |
|---|---------------------------|-------------------------------|
| AA103-72/-72LF One-Bit Digital Attenuator | AA103-72/-72LF            | AA103-72/-72LF-EVB            |

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