

DATA SHEET

AA116-72LF: 4 MHz-2 GHz 1-Bit Digital Attenuator (15 dB LSB)

Applications

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

Features

- 3 V control
- 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.

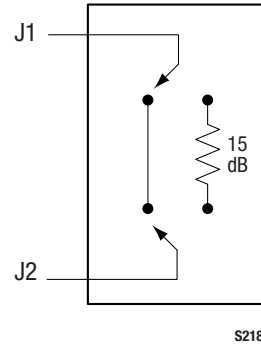


Figure 1. AA116-72LF Block Diagram

Description

The AA116-72LF is a one-bit GaAs FET digital attenuator in a low-cost SOT-5 package. The device has a Least Significant Bit (LSB) of 15 dB and is 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.

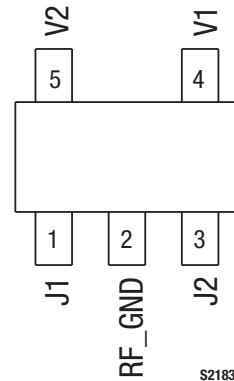


Figure 2. AA116-72LF Pinout – 5-Pin SOT-5
(Top View)

Table 1. AA116-72LF 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. AA116-72LF Absolute Maximum Ratings

| Parameter | Symbol | Minimum | Maximum | Units |
|-----------------------|------------------|---------|---|------------|
| RF input power | P _{IN} | | 1 W > 500 MHz 0/8 V 0.5 W @ 50 MHz 0/8 V | dBm dBm |
| Supply voltage | V _S | | 8 | V |
| Control voltage | V _{CTL} | -0.2 | +8.0 | V |
| Operating temperature | T _{OP} | -40 | +85 | °C |
| Storage temperature | T _{STG} | -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.

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.

Electrical and Mechanical Specifications

The absolute maximum ratings of the AA116-72LF are provided in Table 2. Electrical specifications are provided in Table 3.

Typical performance characteristics of the AA116-72LF are illustrated in Figures 3 through 6.

The state of the AA116-72LF is determined by the logic provided in Table 4.

Table 3. AA116-72LF Electrical Specifications (Note 1)
($V_{CTL} = 0$ to 3 V, $T_{OP} = +25$ °C, Characteristic Impedance [Z_0] = 50 Ω , Unless Otherwise Noted)

| Parameter | Symbol | Test Condition | Min | Typical | Max | Units |
|---|-----------|--|---|---------|------|-------|
| Insertion loss (Note 2) | IL | 0.004 to 0.05 GHz | | 0.35 | 0.45 | dB |
| | | 0.5 to 1.00 GHz | | 0.35 | 0.45 | dB |
| | | 0.85 to 0.94 GHz | | 0.30 | 0.38 | dB |
| | | 1.00 to 2.00 GHz | | 0.40 | 0.50 | dB |
| Attenuation range | | | 15 | | dB | |
| Attenuation accuracy (Note 3) | | 0.004 to 0.05 GHz | 14.0 | 14.6 | 16.0 | dB |
| | | 0.50 to 2.00 GHz | 14.0 | 15.0 | 16.0 | dB |
| | | 0.85 to 0.94 GHz | 14.5 | 15.0 | 15.5 | dB |
| Return loss | | 0.004 to 0.05 GHz | | 30 | | dB |
| | | 0.50 to 1.00 GHz | | 24 | | dB |
| Switching characteristics (Note 4): Rise/fall On/off Video feedthrough | | 10/90% or 90/10% RF 50% V_{CTL} to 90/10% RF $T_{RISE} = 1$ ns, bandwidth = 500 MHz | | 40 | | ns |
| | | | | 50 | | ns |
| | | | | 70 | | mV |
| 1 dB Input Compression Point | IP1dB | 4 to 50 MHz, $V_s = 5$ V | +9 | +12 | | dBm |
| | | 0.5 to 2.5 GHz, $V_s = 3$ V | | +20 | | dBm |
| | | 0.5 to 2.5 GHz, $V_s = 5$ V | | +26 | | dBm |
| 3 rd Order Input Intercept Point | IIP3 | For two-tone input power, +10 dBm/tone, 0.5 to 2.5 GHz $V_s = 3$ V $V_s = 5$ V | | +41 | | dBm |
| | | | | +45 | | dBm |
| Control voltages | V_{CTL} | | $V_{LOW} = 0$ to 0.2 V $V_{HIGH} = 3$ V @ 25 μ A typical to 5 V @ 50 μ A typical | | | |

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 will vary with the value chosen for the blocking capacitors.

Typical Performance Characteristics

($V_{CTL} = 0$ to 3 V, $T_{OP} = +25$ °C, Characteristic Impedance [Z_0] = 50 Ω , Unless Otherwise Noted)

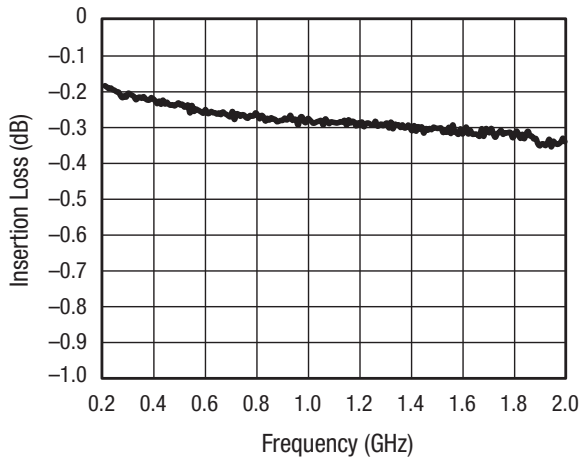


Figure 3. Insertion Loss vs Frequency

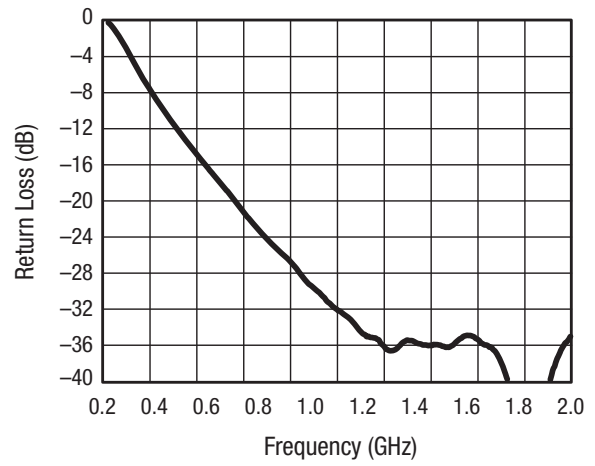


Figure 4. Return Loss in Insertion Loss State vs Frequency

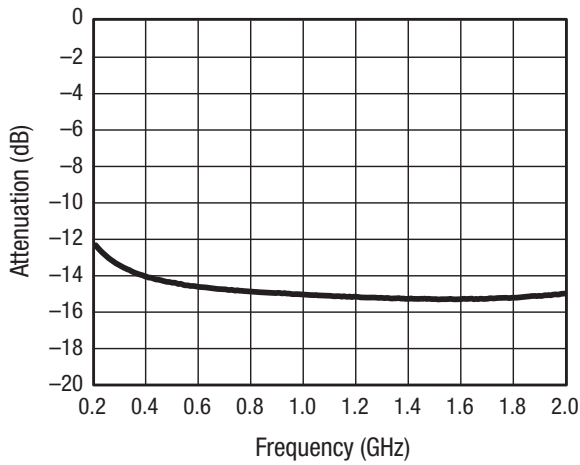


Figure 5. Attenuation vs Frequency

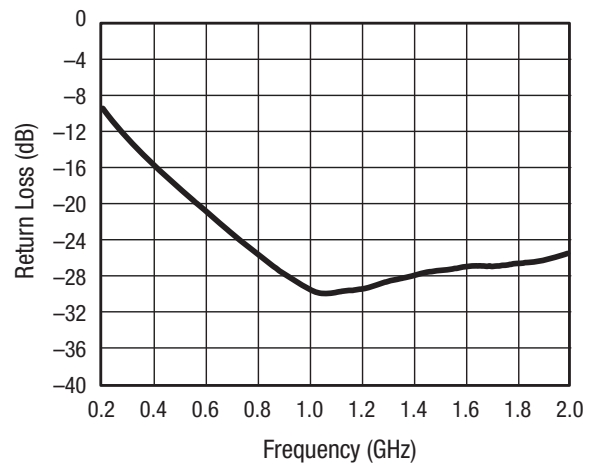


Figure 6. Return Loss in Attenuation State vs Frequency

Table 4. AA116-72LF Truth Table

| J1 to J2 | V1 (Pin 4) | V2 (Pin 5) |
|----------------|-------------------|-------------------|
| Insertion loss | V _{HIGH} | 0 |
| Attenuation | 0 | V _{HIGH} |

Note: V_{HIGH} = +3 V to +5 V
All other conditions not recommended.

Evaluation Board Description

The AA116-72LF Evaluation Board is used to test the performance of the AA116-72LF digital attenuator. An assembly drawing for the Evaluation Board is shown in Figure 7 and an Evaluation Board schematic diagram is shown in Figure 8.

Package Dimensions

The PCB layout footprint for the AA116-72LF is shown in Figure 9. Typical case markings are noted in Figure 10. Package dimensions for the 5-pin SOT-5 are shown in Figure 11, and tape and reel dimensions are provided in Figure 12.

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 AA116-72LF 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.

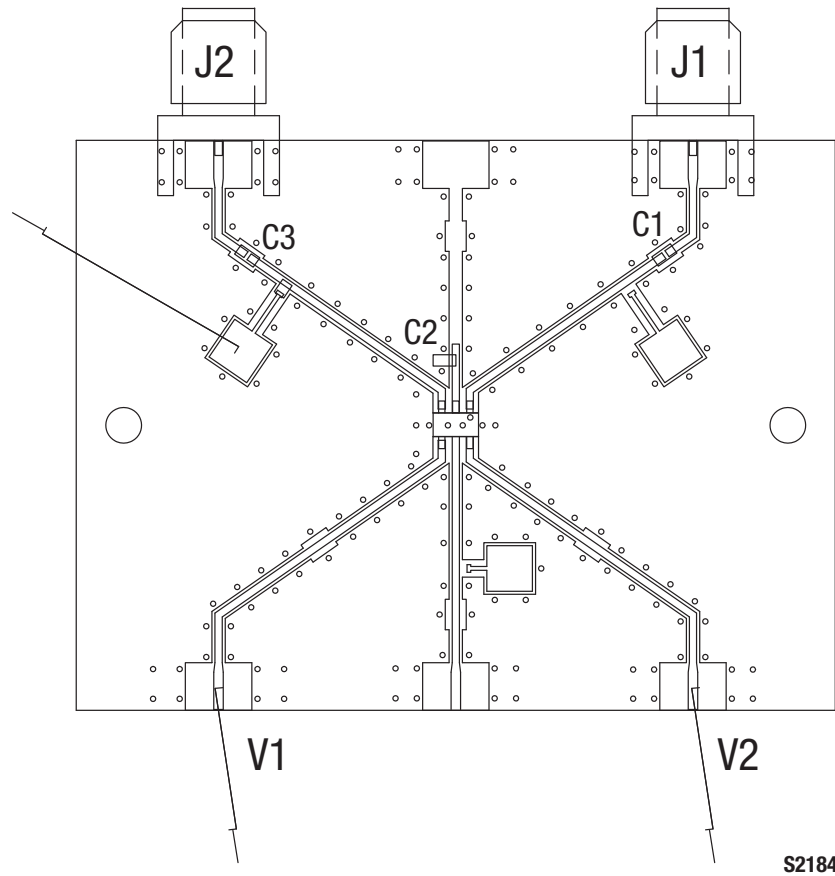
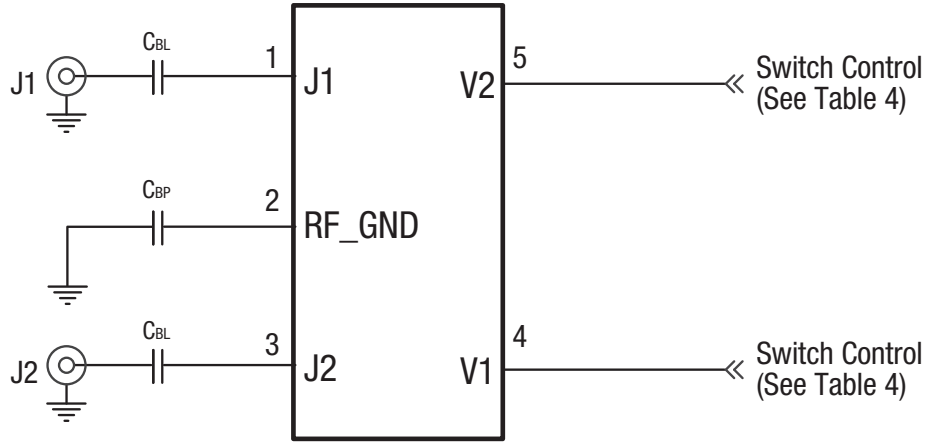


Figure 7. AA116-72LF Evaluation Board Assembly Diagram



Note: $C_{BL} = 33 \text{ pF}$, $C_{BP} = 39 \text{ pF}$ for 900 MHz operation.
 $C_{BL} = 100 \text{ nF}$, $C_{BP} = 100 \text{ nF}$ for 0.004 to 0.05 GHz operation.

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Figure 8. AA116-72LF Evaluation Board Schematic Diagram

*** TBD ***

Figure 9. AA116-72LF PCB Layout Footprint

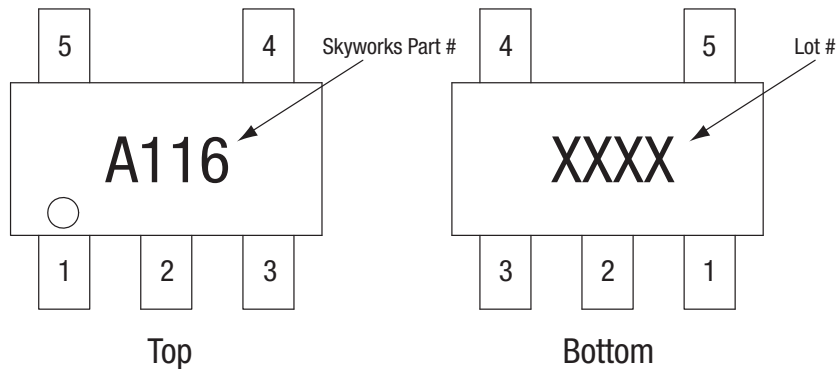
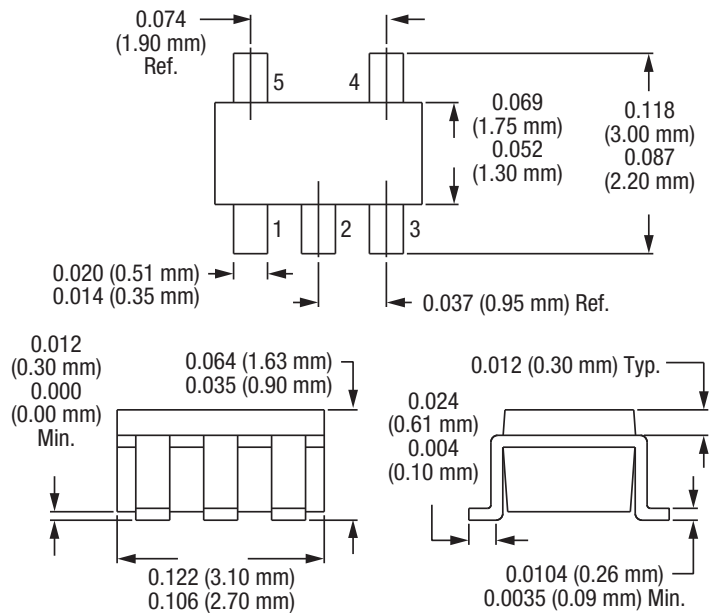


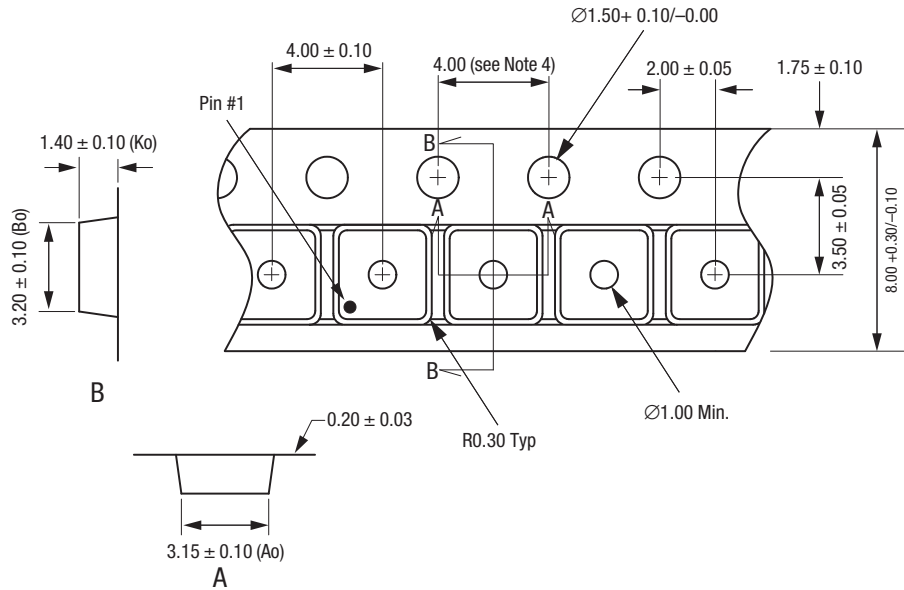
Figure 10. Typical Part Markings



Dimensions are in inches (millimeters shown in parentheses)

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Figure 11. AA116-72LF 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 12. AA116-72LF Tape and Reel Dimensions

Ordering Information

| Model Name | Manufacturing Part Number | Evaluation Board Part Numbers |
|-------------------------------------|---------------------------|-------------------------------|
| AA116-72LF 1-Bit Digital Attenuator | AA116-72LF | AA116-72LF-EVB |

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