INA/MSA RFIC Amplifier Demonstration Board

Assembly and Operating Instructions

Applies to INA-01, INA-02, INA-03, INA-10 and MSA-XXXX RFIC amplifiers

Description

This demonstration board allows you to test and evaluate the performance of the INA–01, INA-02, INA-03, INA-10 and MSA series of RFIC amplifiers under your specific signal conditions. This printed circuit board will accommodate amplifiers in the following package types: 05, 10, 35, 36, 70, 84, 85, 86 and SOT-143. The last two digits of the amplifier part number designate the package type.

General Assembly Information

The amplifier and related components are assembled onto the printed circuit board as shown in Figure 1. For the SOT-143 MSA amplifiers and in Figure 2. For the Non-SOT packaged amplifiers. The INA/MSA circuit board is designed to use edge-mounting SMA connectors such as Johnson Components, Inc., Model 142-0701-881. These connectors are designed to slip over the edge of 0.031-inch thick circuit boards and obviate the need to mount PCBs on a metal base plate for testing. The center conductors of the connectors are soldered to the input and output microstrip lines. The ground pins are soldered to the ground plane on the back of the board and to the top ground pads.

A schematic diagram of the circuit is shown in Figure 3. DC blocking capacitors are required at the input and output of the ICs. The values of the blocking capacitors are determined by the lowest frequency of operation for a particular application. The capacitor's reactance is chosen to be 5% or less of the amplifier's input or output impedance at the lowest operating frequency. For example, an amplifier to be used in an application covering the 433 to 450 MHz band would require an input blocking capacitor of at least 140 pF, which is 2.5 Ω of reactance, or 5% of 50 Ω at 450 MHz. The Vcc connection to the amplifier must be RF bypassed by placing a capacitor to ground at the bias pad of the board. Like the DC blocking capacitors, the value of the Vcc bypass capacitor is determined by the lowest operating frequency

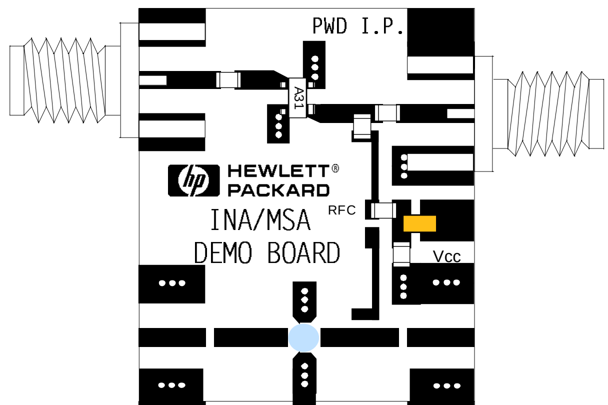

Figure 1. SOT-143 Assembly Drawing

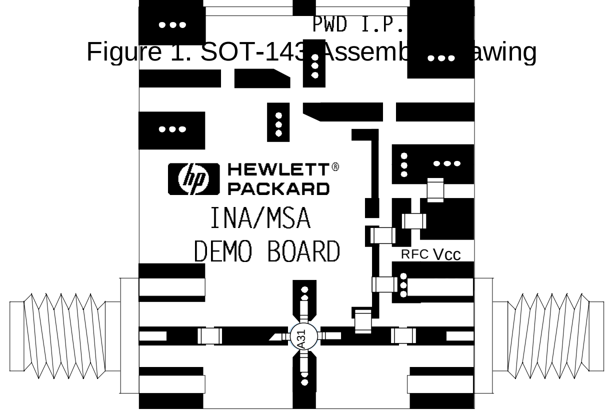

Figure 2. Non-SOT Assembly Drawing

for the amplifier. This value is typically the same as that of the DC blocking capacitors. Space is available on the circuit board to add a bias choke, bypass capacitors, and collector resistors. The MSA series of ICs normally require a bias resistor to ensure thermal stability. A gap between the bias feed point and the output microstrip line permits mounting of a chip resistor. This collector resistance can be divided into two parts to allow one bias resistor Rc1 in Figure 3. to load the IC output and/or reduce gain while improving output VSWR and reverse isolation at the same time, a technique sometimes used with the INA-03.

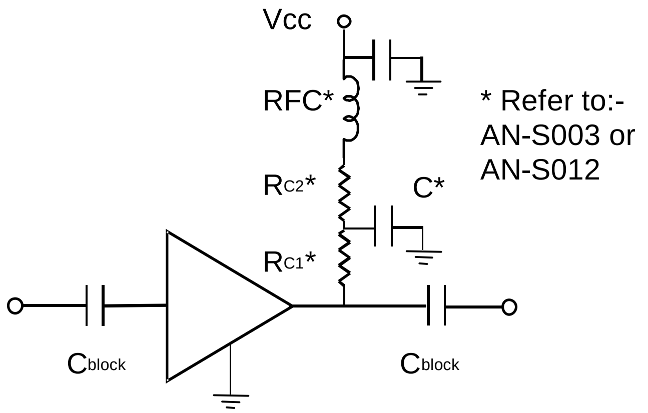

Figure 3. Schematic Diagram

Operation

The MSA series of RFIC amplifiers are current controlled devices. The INA-01, INA-02, INA-03 and the INA-10 series of RFIC amplifiers are predominantly current biased devices. Test data reveals that although the least variation in gain occurs when the INA series RFICs are operated from a current source, it is possible to operate these devices directly from a voltage source. When applying bias to the board, start at a low voltage level and slowly increase the voltage until the recommended current (MSA series) or voltage (INA series) is reached. Both power and gain can be adjusted by varying Id. Curves of typical performance as a function of bias current are shown on the individual RFIC datasheets.

Notes on RF grounding

The performance of the INA series is sensitive to ground path inductance. The two-stage design creates the possibility of a feedback loop being formed through the ground returns of the stages.

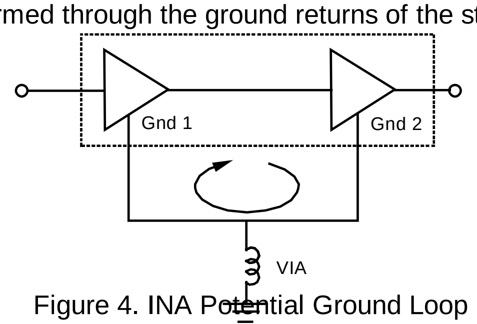

Figure 4. INA Potential Ground Loop

Excellent grounding is critical when using the INA series. The use of via holes or equivalent minimal path ground returns as close to the package edge as is practical is recommended to assure good RF grounding. Multiple vias are used on the evaluation board to reduce the inductance of the path to ground.

The effects of the potential ground loop shown in Figure 4 may be observed as a "peaking" in the gain versus frequency response, an increase in input VSWR, or even as return gain at the input of the RFIC.

A Final Note on Performance

Actual performance of the INA/MSA RFIC mounted on the demonstration board may not exactly match data sheet specifications. The board material, passive components, and connectors all introduce losses and parasitics that may degrade device performance, especially at higher frequencies. Some variation in measured results is also to be expected as a result of the normal manufacturing distribution of products.

References

Performance data for INA and MSA series amplifiers are found in the HP Communication Components Designers Catalog, CD ROM or http://www.hp.com/go/rf

Application Notes

AN-S001 Basic MODAMP MMIC Circuit Techniques
AN-S002 MODAMP MMIC Nomenclature
AN-S003 Biasing MODAMP MMICs
AN-S011: Using Silicon MMIC Gain Blocks as Transimpedance Amplifiers
AN-S012 MagIC Low Noise Amplifiers
AN 1071: Battery Operation of the INA-03184
AN-A001 Notes on Choke Network Design

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