APPLICATION NOTE

Bias Tee Component Selection Guidelines for Distributed Amplifiers Using Conical Inductors and Broadband Capacitors

Introduction

Qorvo offers a wide selection of broadband or distributed products that can be operated over large frequency ranges. For some distributed products such as the CMD242K4 which is a DC to 40 GHz distributed amplifier, a bias tee that is created using a conical inductor and a broadband capacitor is recommended. This is because bias tees are not only relatively simple in design, but they are also very effective in being able to set DC bias points while isolating the AC signal from the DC source without negatively impacting overall device performance. The selection of bias tee components is critical to see optimal performance specifically for distributed products. This application note provides the key guidelines that should be taken into consideration when selecting bias tee components for distributed products.

Prior to selecting bias tee components for a specific device, refer to the corresponding datasheet for more detailed information regarding the bias tee component specifications, and device parameters such as operating frequency range, maximum supply current and maximum voltage. Only select distributed products require the implementation of bias tees that use conical inductors, and as such they should only be used when recommended by the product datasheet. To realize the implementation of a bias tee, contact Qorvo application support.

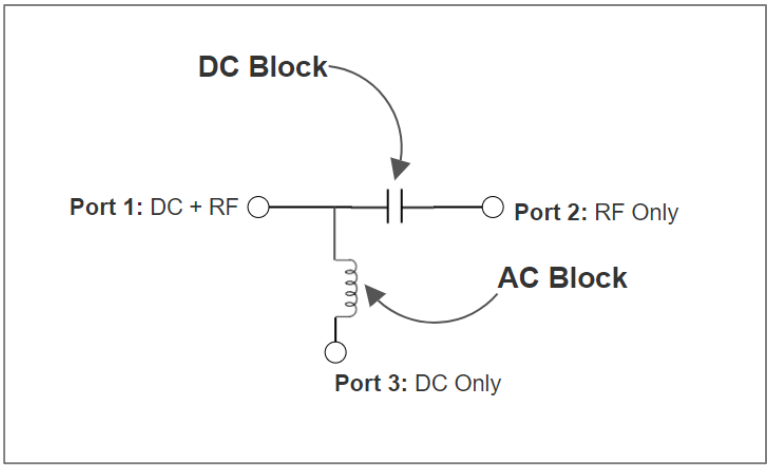

Figure 1: Bias Tee Configuration

Bias Tee Component Selection Recommendations

Conical Inductor Component Selection

While there are several different types of inductors, for some distributed products conical inductors are the preferred type of inductor used in bias tee configurations. This is because conical inductors intrinsic attributes limit the introduction of factors that contribute to performance degradation when used with distributed devices. Unlike many other commonly used inductors, conical inductors have reduced stray parasitic capacitances, and good return loss over very wide frequency bands. However, even with these inherent

characteristics of conical inductors, it is still critical to verify the parameters and performance of a conical inductor prior to selecting it to be used with a distributed device. For the inductor to behave more ideally, the quality factor or Q factor of the inductor should be chosen to be as high as possible. It should also be ensured that the insertion loss and return loss of the inductor selected are such that they do not limit the overall performance device or application. An example of the expected insertion loss and return loss of broadband conical inductor taken in a shunt configuration can be seen in Figure 2 and Figure 3 below.

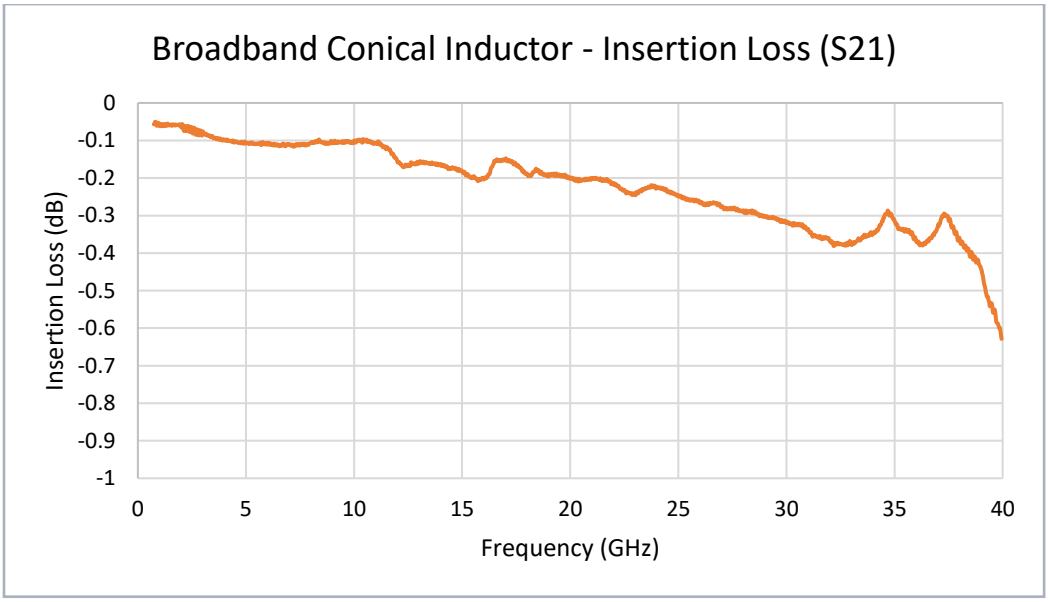

Figure 2. Insertion Loss of Piconics Broadband Conical Inductor

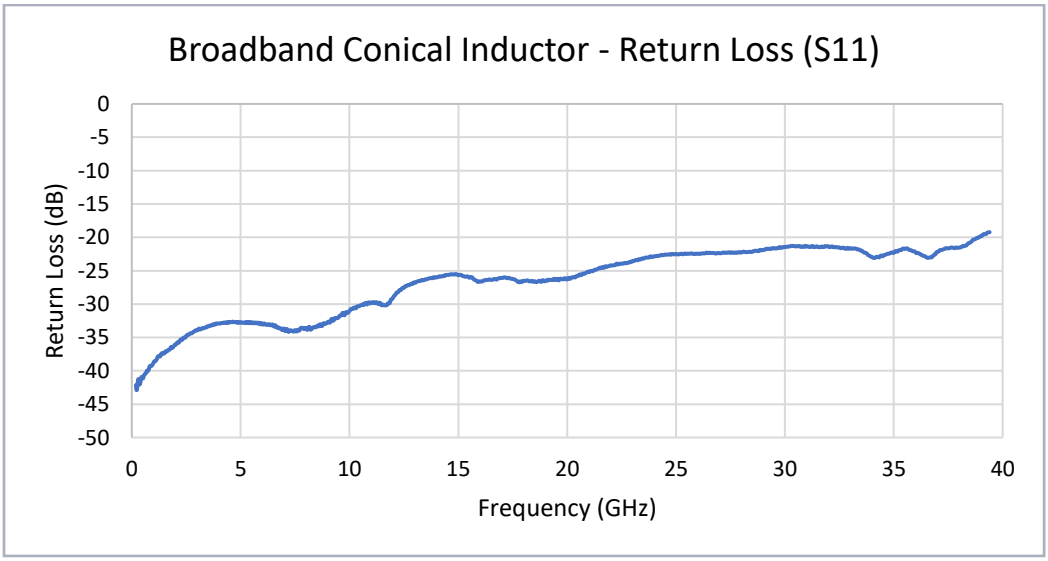

Figure 3. Return Loss of Piconics Broadband Conical Inductor

Conical Inductor Component Selection - Broadband Packaged & Die Devices

Surface mount packaged conical inductors are preferable for distributed devices in a packaged form. The inductor is mounted and held at the ideal 45-degree angle inside the package. Flying lead conical inductors which are not enclosed in a package, can also be used for devices in packaged form, however they are not recommended. This is because flying lead conical inductors leave the mounting angle up to the assembler to ensure that the required 45-degree mounting angle is achieved. If the inductor is not installed with the correct mounting angle, a variety of issues can be seen in the performance of an application. For distributed die devices, conical inductors mounted on a substrate integrated with a 50Ω microstrip, are the preferred option. Not only do they come pre-mounted on a substrate with soft gold terminations which makes them easy to use and implement for chip and wire applications. These conical inductors also come pre-mounted at the ideal angle which ensures that the coupling with the substrate is mitigated for optimal performance.

Inductor Component Selection – Power Handling

Inductor selection requires sufficient power handing for the specific application. To ensure the inductor will not be damaged from overpower, Qorvo generally recommends a minimum of 1.5 times the maximum current level the inductor will be exposed to in application. For example, if the maximum current for the device being used in the application is 250 mA, then the inductor selected should have a maximum current handling of at least 375 mA or greater to make sure that it is not damaged in operation.

Capacitor Component Selection

When selecting a capacitor for a distributed device, there are several performance attributes that should be considered. For the specific applications operating frequency band, it should be ensured that the capacitor chosen has a high Q factor and a low ESR. Additionally, other parameters such as the insertion loss and return loss of the broadband capacitor should be chosen such that they do not limit the performance. An example of insertion loss and return loss of broadband capacitor can be seen below in Figure 4 and Figure 5.

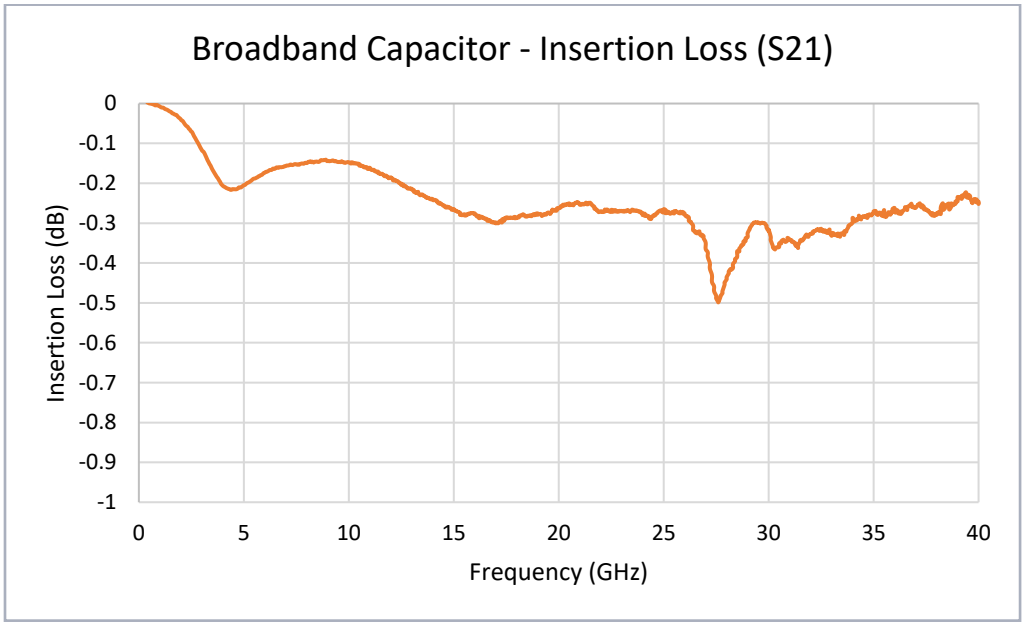

Figure 4. Insertion Loss of ATC Broadband Capacitor

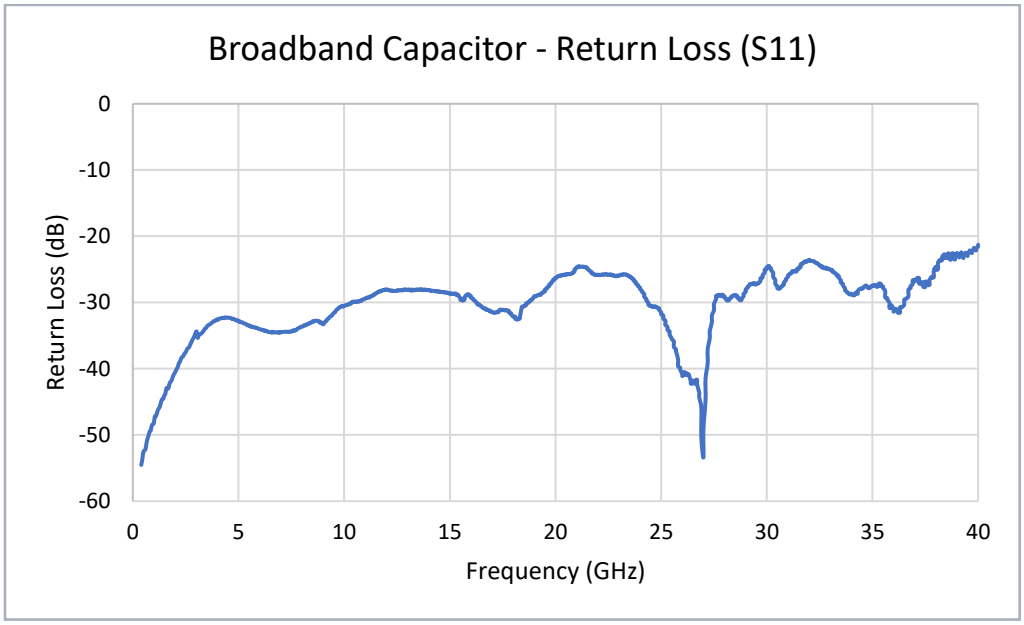

Figure 5. Return Loss of ATC Broadband Capacitor

Capacitor Component Selection – Power Handling

Qorvo recommends that capacitors are selected such that the maximum voltage rating is a minimum of 1.5 times greater than the maximum voltage that the capacitors may be exposed to in the application environment they are being used in. Similar to inductors being stressed or damaged by over current, capacitors can be easily damaged when subjected to voltages that are close to or reach the maximum voltage rating. Even if a capacitor is not damaged by operating close to or at the maximum voltage rating, the effective capacitance can significantly change due to the capacitors intrinsic dielectric constant changing with voltage, which can negatively impact performance.

Contact Information

For the latest specifications, additional product information, worldwide sales and distribution locations:

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