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BIASING CIRCUIT

Abstract

A biasing circuit includes a signal input terminal, a signal output terminal, a first inductor, and a second inductor. The first inductor is with one end connected to a node between the signal input terminal and the signal output terminal. The second inductor is with one end connected to an other end of the first inductor. The first inductor includes a core that is formed by a bulk of ferrite. The second inductor includes a core that is formed by a bulk of high permeability material.

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Background/Summary

TECHNICAL FIELD

[0001] The present invention relates to a biasing circuit.

BACKGROUND ART

[0002] There have conventionally been known bias tees in which one end of an inductor is connected to a node between a signal input terminal and a signal output terminal, while the other end of the inductor is grounded. The core of the inductor is formed by solidifying powder of high permeability material with carbon binder or by ferrite of high resistance material to reduce eddy current loss.

[0003] It is noted that Patent Literatures 1 and 4 each describe a biasing circuit. Also, Patent Literatures 2 and 3 each describe a filter.

CITATION LIST

Patent Literature

[0004] Patent Literature 1: Japanese Patent Application Publication No. 2018-078495 [0005] Patent Literature 2: Japanese Patent Application Publication No. 2004-040444 [0006] Patent Literature 3: Japanese Patent Application Publication No. 2000-151324 [0007] Patent Literature 4: Japanese Patent Application Publication No. H7-183766

SUMMARY OF THE INVENTION

Technical Problem

[0008] However, the core of such an inductor, even if may be formed by solidifying powder of high permeability material with carbon binder or by ferrite of high resistance material as described in the related arts above, can suffer from a reduction in the permeability and therefore the inductance. This can cause the frequency band on the low-frequency side of the output of the signal output terminal to become narrower.

[0009] It is hence an object of the present invention to widen the frequency band on the low-frequency side of the output of a biasing circuit.

Means for Solving the Problem

[0010] According to a first aspect of the present invention, a biasing circuit includes: a signal input terminal; a signal output terminal; a first inductor with one end connected to a node between the signal input terminal and the signal output terminal; and a second inductor with one end connected to an other end of the first inductor, wherein the first inductor includes a core that is formed by a bulk of ferrite, and the second inductor includes a core that is formed by a bulk of high permeability material.

[0011] According to the thus constructed first aspect of biasing circuit, a first inductor is with one end connected to a node between the signal input terminal and the signal output terminal. A second inductor is with one end connected to an other end of the first inductor. The first inductor includes a core that is formed by a bulk of ferrite. The second inductor includes a core that is formed by a bulk of high permeability material.

[0012] According to a second aspect of the present invention, a biasing circuit includes: a signal input terminal: a signal output terminal: a first inductor with one end connected to a node between the signal input terminal and the signal output terminal; and a second inductor with one end connected to an other end of the first inductor, wherein the first inductor includes a core that is formed by molding powder of high permeability material with carbon binder, and the second inductor includes a core that is formed by a bulk of high permeability material.

[0013] According to the thus constructed second aspect of biasing circuit, a first inductor is with one end connected to a node between the signal input terminal and the signal output terminal. A second inductor is with one end connected to an other end of the first inductor. The first inductor includes a core that is formed by molding powder of high permeability material with carbon binder. The second inductor includes a core that is formed by a bulk of high permeability material.

[0014] According to the biasing circuit of the first and the second aspects of the present invention,

the high permeability material may have a specific permeability of higher than 500.
[0015] According to the biasing circuit of the first and the second aspects of the present invention, the other end of the second inductor may be grounded.
[0016] According to the biasing circuit of the second aspect of the present invention, the core of the first inductor may be formed by molding powder of iron, iron-based nanocrystallized material, high-purity iron, permendur, or silicon steel with carbon binder.
[0017] According to the biasing circuit of the first and the second aspects of the present invention, the core of the second inductor may be formed by a bulk of pure iron, amorphous magnetic material, iron-based nanocrystallized material, high-purity iron, permendur, silicon steel, permalloy, or supermalloy.

Description

BRIEF DESCRIPTION OF DRAWINGS
[0018] FIG. **1** is a circuit diagram showing a biasing circuit **1** according to an embodiment of the present invention.
MODES FOR CARRYING OUT THE INVENTION
[0019] A description will now be given of an embodiment of the present invention referring to drawings.
[0020] FIG. **1** is a circuit diagram showing a biasing circuit **1** according to an embodiment of the present invention. The biasing circuit **1** according to the embodiment of the present invention includes a signal input terminal (RFin) **2**, a signal output terminal (RFout) **4**, nodes **6**, **8**, a first inductor **12**, and a second inductor **14**. The biasing circuit **1** according to the embodiment of the present invention is a bias tee.
[0021] A signal (e.g. high frequency signal) is input to the signal input terminal (RFin) **2**. A signal (e.g. high frequency signal) is output from the signal output terminal (RFout) **4**. The node **6** is provided between the signal input terminal **2** and the signal output terminal **4**.
[0022] One end of the first inductor **12** is connected to the node **6**. The other end of the first inductor **12** and one end of the second inductor **14** are connected to the node **8**. Accordingly, the other end of the first inductor **12** is connected with the one end of the second inductor **14**. Also, the other end of the second inductor **14** is grounded.
[0023] It is noted that the first inductor **12** and the second inductor **14** each serve as a low pass filter. The cutoff frequency of the first inductor **12** is higher than the cutoff frequency of the second inductor **14**.
[0024] The first inductor **12** includes a core that is formed by a bulk of ferrite or by molding powder of high permeability material (e.g. iron, iron-based nanocrystallized material, high-purity iron, permendur, or silicon steel) with carbon binder.
[0025] The second inductor **14** includes a core that is formed by a bulk of high permeability material (e.g. pure iron, amorphous magnetic material, iron-based nanocrystallized material, high-purity iron, permendur, silicon steel, permalloy, or supermalloy).
[0026] It is noted that the high permeability material above means material that is sensitively magnetized by an external magnetic field and has, for example, a specific permeability of higher than 500.
[0027] Next will be described an operation according to the embodiment of the present invention.
[0028] A signal that has a high frequency component fHin and a low frequency component fLin is input to the signal input terminal (RFin) **2**. It is noted that the cutoff frequency of the first inductor **12** is lower than the frequency of the high frequency component fHin but higher than the frequency of the low frequency component fLin. On the other hand, the cutoff frequency of the second inductor **14** is lower than the frequency of the low frequency component fLin.

[0029] The high frequency component fHin passes through the node **6**, provided to and reflected by the first inductor **12**, and output as a high frequency component fHout from the signal output terminal (RFout) **4**. Here, the core of the first inductor **12** is formed by a bulk of ferrite or by molding powder of high permeability material with carbon binder and thereby undergoes reduced eddy current loss.
[0030] The low frequency component fLin passes through the node **6** and the first inductor **12**, provided to and reflected by the second inductor **14**, passes through the first inductor **12** and the node **6**, and output as a low frequency component fLout from the signal output terminal (RFout) **4**.
[0031] In accordance with the embodiment of the present invention, the core of the first inductor **12** is formed by a bulk of ferrite or by molding powder of high permeability material with carbon binder and thereby undergoes reduced eddy current loss.
[0032] Additionally, in accordance with the embodiment of the present invention, the core of the second inductor **14**, which is formed by a bulk of high permeability material, can have higher permeability and therefore higher inductance, whereby the inductor can have a lower cutoff frequency, compared to the core of the first inductor **12**, which is formed by a bulk of ferrite or by molding powder of high permeability material with carbon binder.
[0033] In addition, since a component with a frequency higher than the cutoff frequency of the second inductor **14** is reflected by the second inductor **14** and output from the signal output terminal (RFout) **4**, the frequency band on the low-frequency side of the output of the biasing circuit **1** becomes wider as the second inductor **14** has a lower cutoff frequency.
[0034] That is, in accordance with the embodiment of the present invention, since the second inductor **14** can have a lower cutoff frequency, the frequency band on the low-frequency side of the output of the biasing circuit **1** can become wider.
[0035] Note here that if a current flowed through the second inductor **14**, the eddy current loss in the second inductor **14** would be increased. However, since the low frequency component fLin is reflected by the second inductor **14**, no current substantially flows through the second inductor **14**. The eddy current loss in the second inductor **14** can therefore be reduced (even though, unlike the first inductor **12**, the core is not formed by a bulk of ferrite or by molding powder of high permeability material with carbon binder).
DESCRIPTION OF REFERENCE NUMERALS
[0036] **1** Biasing Circuit [0037] **2** Signal Input Terminal (RFin) [0038] **4** Signal Output Terminal (RFout) [0039] **6**, **8** Nodes [0040] **12** First Inductor [0041] **14** Second Inductor [0042] MHin, fHout High Frequency Component [0043] fLin, fLout Low Frequency Component

Claims

1. A biasing circuit, comprising: a signal input terminal; a signal output terminal; a first inductor with one end connected to a node between the signal input terminal and the signal output terminal; and a second inductor with one end connected to an other end of the first inductor, wherein the first inductor includes a core that is formed by a bulk of ferrite, and the second inductor includes a core that is formed by a bulk of high permeability material.
2. A biasing circuit, comprising: a signal input terminal; a signal output terminal; a first inductor with one end connected to a node between the signal input terminal and the signal output terminal; and a second inductor with one end connected to an other end of the first inductor, wherein the first inductor includes a core that is formed by molding powder of high permeability material with carbon binder, and the second inductor includes a core that is formed by a bulk of high permeability material.
3. The biasing circuit according to claim 1, wherein the high permeability material has a specific permeability of higher than 500.
4. The biasing circuit according to claim 1, wherein the other end of the second inductor is

grounded.

5. The biasing circuit according to claim 2, wherein the core of the first inductor is formed by molding powder of iron, iron-based nanocrystallized material, high-purity iron, permendur, or silicon steel with carbon binder.

6. The biasing circuit according to claim 1, wherein the core of the second inductor is formed by a bulk of pure iron, amorphous magnetic material, iron-based nanocrystallized material, high-purity iron, permendur, silicon steel, permalloy, or supermalloy.

7. The biasing circuit according to claim 2, wherein the high permeability material has a specific permeability of higher than 500.

8. The biasing circuit according to claim 2, wherein the other end of the second inductor is grounded.

9. The biasing circuit according to claim 2, wherein the core of the second inductor is formed by a bulk of pure iron, amorphous magnetic material, iron-based nanocrystallized material, high-purity iron, permendur, silicon steel, permalloy, or supermalloy.