# Application Note No. 022

## Simple Microstrip Matching for all Impedances

RF & Protection Devices

Never stop thinking

**Edition 2007-01-17**

**Published by**
**Infineon Technologies AG**
**81726 München, Germany**



**LEGAL DISCLAIMER**

THE INFORMATION GIVEN IN THIS APPLICATION NOTE IS GIVEN AS A HINT FOR THE IMPLEMENTATION OF THE INFINEON TECHNOLOGIES COMPONENT ONLY AND SHALL NOT BE REGARDED AS ANY DESCRIPTION OR WARRANTY OF A CERTAIN FUNCTIONALITY, CONDITION OR QUALITY OF THE INFINEON TECHNOLOGIES COMPONENT. THE RECIPIENT OF THIS APPLICATION NOTE MUST VERIFY ANY FUNCTION DESCRIBED HEREIN IN THE REAL APPLICATION. INFINEON TECHNOLOGIES HEREBY DISCLAIMS ANY AND ALL WARRANTIES AND LIABILITIES OF ANY KIND (INCLUDING WITHOUT LIMITATION WARRANTIES OF NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS OF ANY THIRD PARTY) WITH RESPECT TO ANY AND ALL INFORMATION GIVEN IN THIS APPLICATION NOTE.

**Information**

For further information on technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies Office (**www.infineon.com**).

**Warnings**

Due to technical requirements components may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies Office.

Infineon Technologies Components may only be used in life-support devices or systems with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system, or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body, or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

**Simple Microstrip Matching for all Impedances**

**Revision History: 2007-01-17, Rev. 2.0**

**Previous Version: 2000-07-28**

| Page | Subjects (major changes since last revision) |
|---|---|
| All | Document layout change |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

# 1 Simple Microstrip Matching for all Impendances

During the evaluation of new devices, it is often difficult to find a simple matching circuit to a 50 Ω impedance.

In a 50 Ω coax fixture this can be achieved by adjusting two slide screw tuners, which apply a movable variable capacitance to a triplate line.

In a practical application, matching is often performed using printed microstrip lines. Such layouts often require a large amount of effort in design and simulation to reach a solution. This effort can be reduced by using a simple “universal printed circuit board”, which can realise all transformations to the device under test. Such a “universal printed circuit board” is presented below.

## 1.1 Realisation

A universal printed circuit board consists of two straight 50 Ω lines at the input and output of the device under test, with an electrical length of at least λ/2 at operating frequency.

Alongside these λ/2 lines sufficient space is left for movable λ/4 open stub lines.

Biasing can be provided by small λ/4- lines on the board as shown below, or through external bias tees.

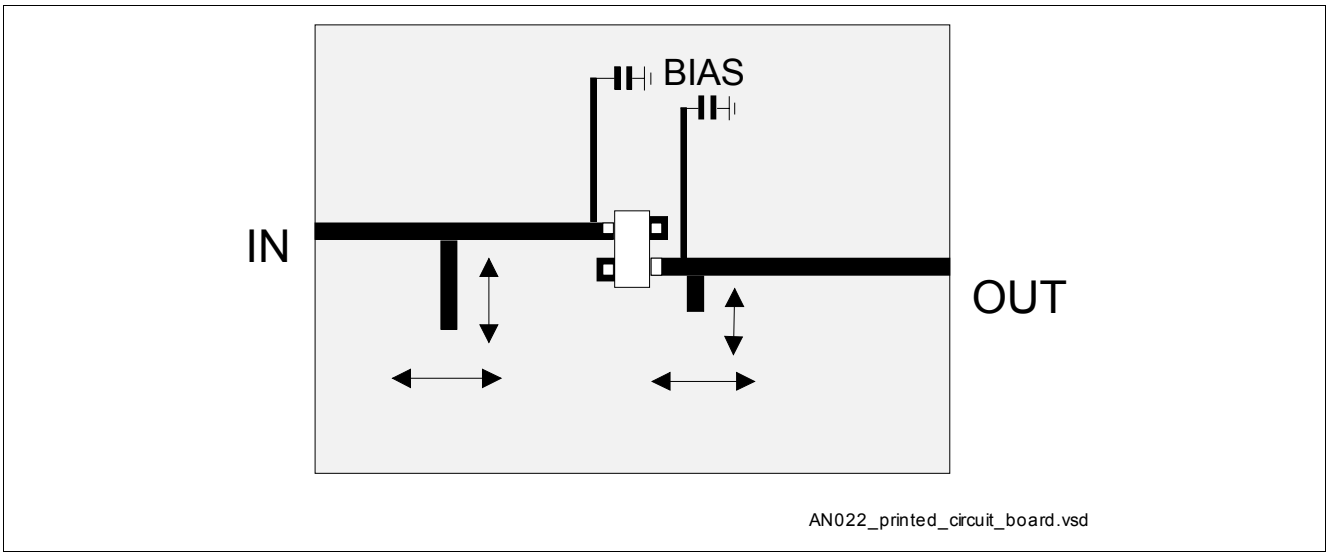


**Figure 1 Universal printed circuit board**

Using such a universal printed circuit board it is possible to match all (!) impedances to 50 Ω by applying movable open 50 Ω stubs with variable length. The stubs can be made from strips of copper or brass foil which can be moved along the input and output lines using a soldering iron and cut in length. If they become too short, they can be simply replaced by new strips. The width of these strips determines the impedance and should therefore be the same as the lines on the pcb.

Although this method is a simple cut and try strategy, it is very fast and effective.

## 1.2 Theory

In order to match an impedance to 50 Ω a matching network is required. This network must apply the conjugate complex impedance to the impedance of the device under test. The impedance seen looking into a device is called S (e.g.$S_{11}$) and the impedance seen looking from the device into the matching circuit is named Γ. Both impedances have the same magnitude and a conjugate angle.

An open stub with variable length acts as a variable parallel capacitor which adjusts the magnitude of the reflection coefficient on the 20 mS circle. The distance of this stub from the device adjusts the phase.

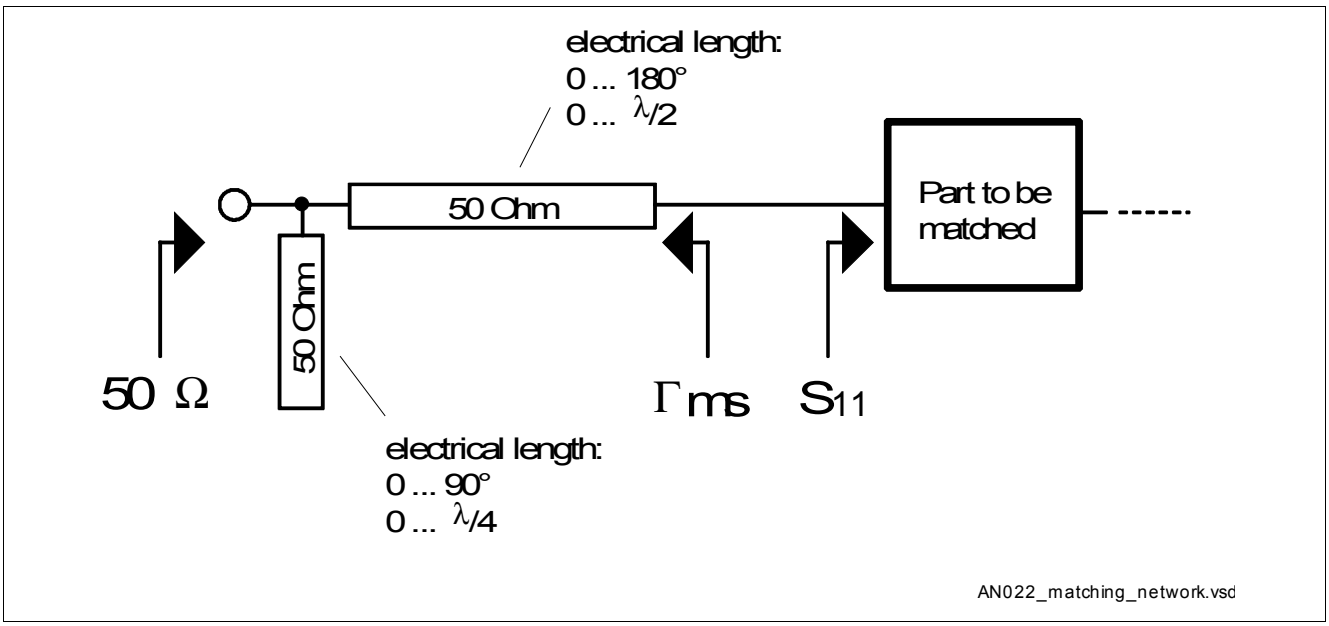


**Figure 2**

## 1.3 Practical realisation

An open stub at the device port acts as capacitor to ground. By varying the length of the stub between 0 and λ/4 the capacitance value varies between 0 and ∞. Therefore all magnitudes of the impedance between 0 and 1 can be adjusted.

The phase can then be adjusted by varying the length of the 5 Ω line between the device and the stub. This can done by moving the open stub away from the device under test.

The length can vary between 0 and λ/2, which is once around the smith chart.

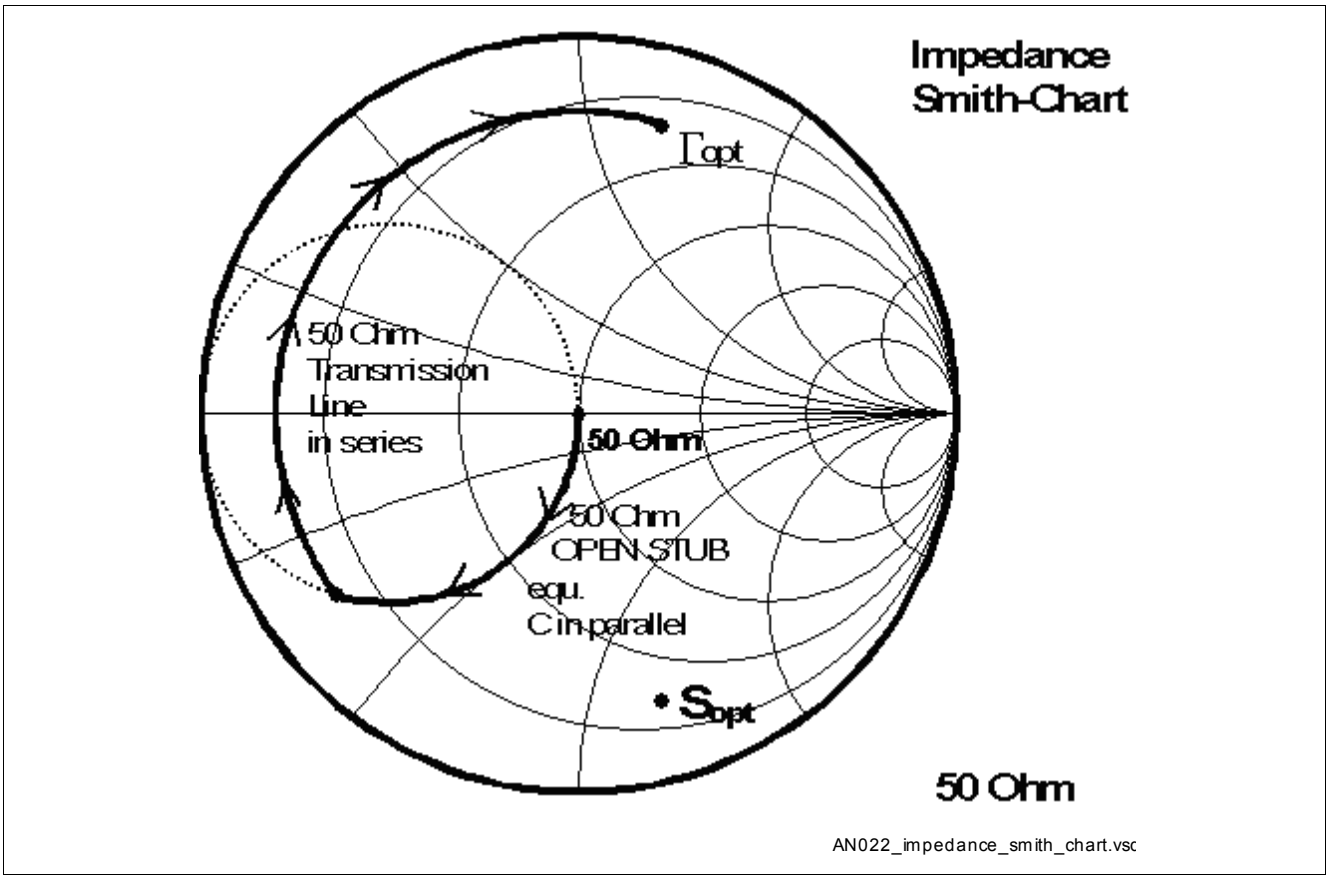


**Figure 3 Impedance Smith-Chart**

An example on the smith chart shows that all impedances can be realised on the universal printed circuit board.

For low frequencies the movable stubs can be replaced by adjustable capacitors to ground.