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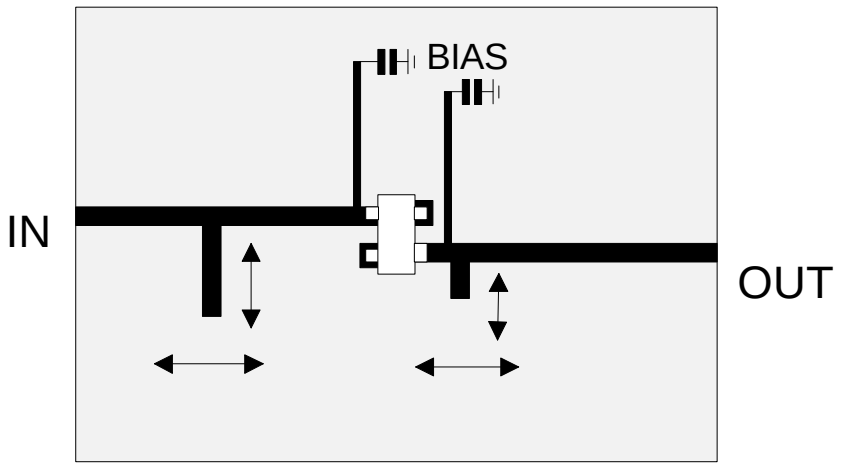
Simple Microstrip Matching for all Impedances

During evaluation phase of new devices, it is often a problem to find a simple matching circuit to 50Ω impedance. In a 50Ω coax test fixture it is done by two slide screw tuners, which can apply a movable variable capacitance to a sort of triplate line.
Normal microstrip layouts sometimes take large efforts in design and simulation until a layout is available. This can be shortened by a universal printed circuit board, where all transformations to the device under test can be realized. One of the possible simple and universal solutions will be presented here.

Realization:

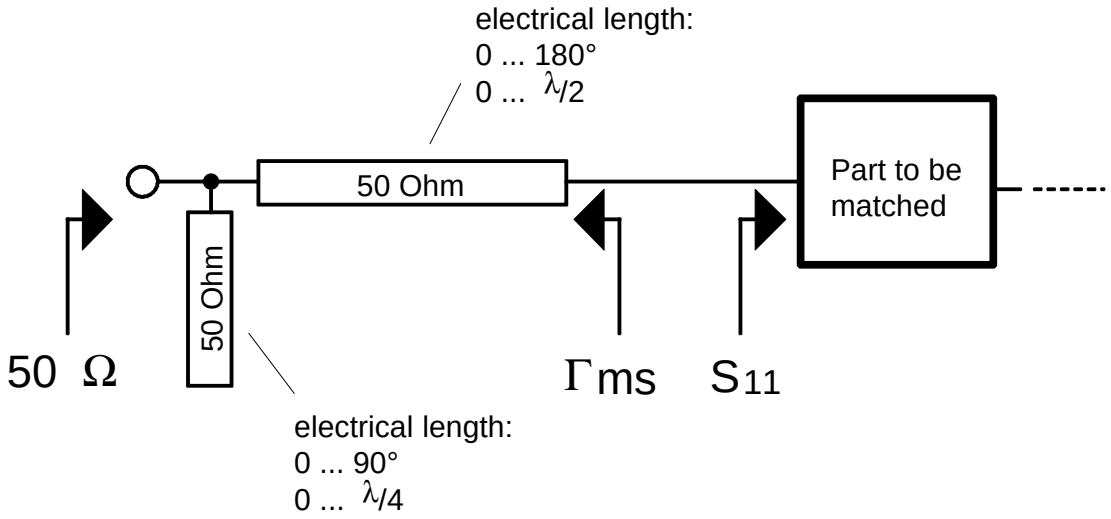
What you need is a universal printed circuit board which applies a straight 50Ω line at input and output of the device, e.g. transistor. This lines must have an electrical length of at least λ/2 at operating frequency. The biasing can be done by small λ/4-lines on the board or by bias tees outside the board. Beside the λ/2 lines at input and output there must be enough room for a movable λ/4 open stub with also 50Ω impedance.



On this universal printed circuit board it is possible to match all (!) impedances to 50Ω by applying movable open stubs with about 50Ω impedance and variable length. The stubs can be realized by copper or brass foil which can be moved by the soldering iron and cut in length. If it is too short it can be replaced by a new one. The method is a simple cut and try strategy but very fast and effective.

Theory:

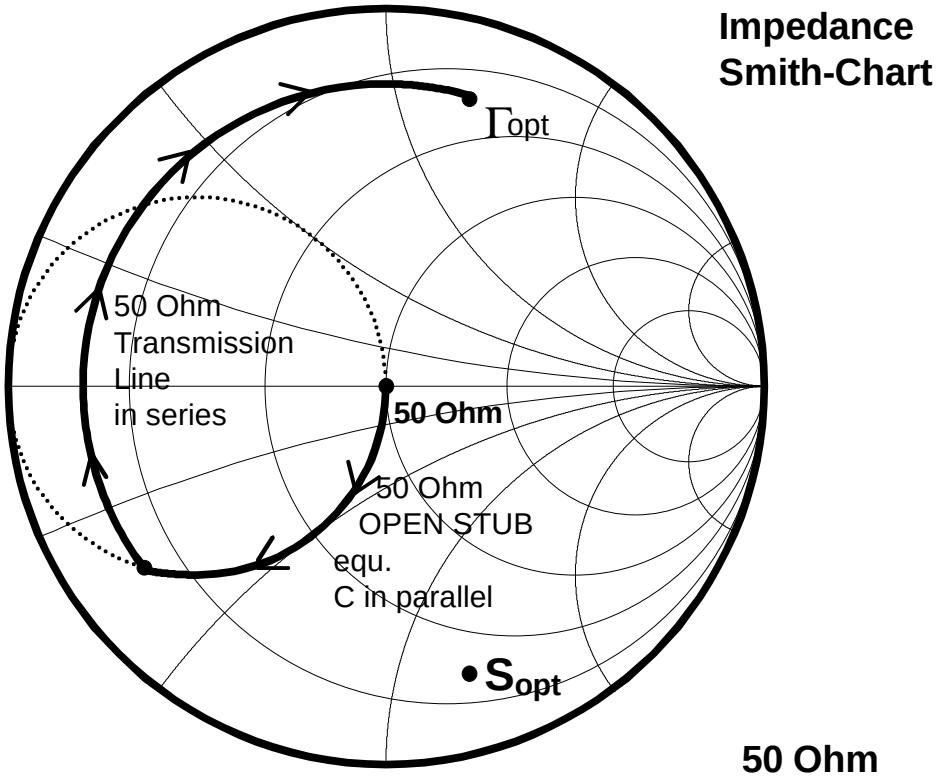
To match an impedance to 50Ω, the matching network must apply a conjugate complex impedance to the needed impedance. The impedance which can be seen by looking into a device is named S (e.g. S_{11}) and the impedance which can be seen by looking from the device into the matching circuit is named Γ. Both impedances have the same magnitude and a conjugate angle. An open stub with variable length acts as variable parallel capacitor which adjusts the magnitude of the reflection coefficient on the 20mS circle. A 50Ω line with variable length to the device adjusts the phase.



Practical realization:

An open stub at the input acts as capacitor to ground. By varying the length 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.

Now the magnitude is O.K. and the phase can be adjusted by a 50Ω line in series with variable length. This length variation is done by moving the open stub. The length can vary between 0 and λ/2, which is one time around the smith chart.



An example in the smith chart shows, that all needed impedances can be realized on the universal printed circuit board.

The stubs can be either metal foil, moved by the soldering iron on a universal printed circuit board or the 50Ω line at input and output can be realized by small 50Ω stripes of printed circuit material soldered to a ground plane and the stubs can also be adjustable capacitors to ground for lower frequencies.

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