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FEKO

Comprehensive Electromagnetic Solutions

Designing an Impedance Matched Antenna: FEKO and Optenni Lab

Optenni Lab in the Design Cycle

Optenni Lab is a fast and easy-to-use matching circuit generation and antenna analysis tool tailored for antenna designers. Once a designer has decided on the basic design of an antenna, Optenni Lab enables fast, automatic matching circuit design. It can estimate the obtainable bandwidth of the antenna at various frequencies.

What makes these passive component matching network designs valuable is its use of component values available off-the-shelf from the catalogues of leading component manufacturers. The simplicity of the matching network design process is equally matched to the sourcing of components and building of prototypes. Additionally, Optenni Lab empowers users to perform tolerance analysis to estimate the effect of non-ideal component values.

The necessity of a good matching circuit for any antenna system becomes obvious when considering the following reasons:

- For efficient operation, an antenna's impedance must be close to the output impedance of the preceding electronics.
- It is much simpler to adjust antenna impedance via a matching network than via the redesign of the fundamental antenna geometry.
- A good matching circuit allows the designer the freedom to change critical system parameters at a late design stage.
- Antenna performance bandwidth can be improved significantly with a good matching network.

The following examples demonstrate the value of Optenni Lab in the antenna design cycle along with FEKO.

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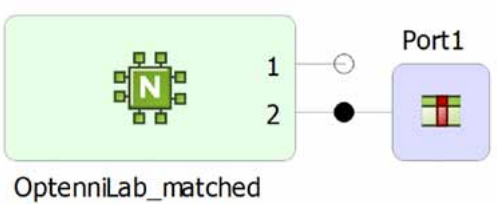
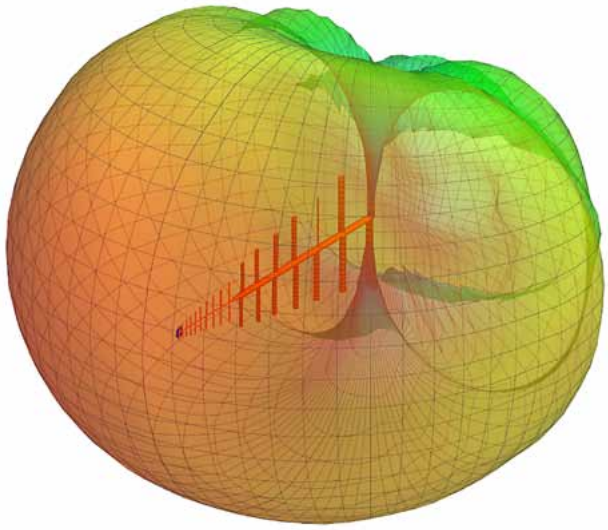


Integration of matching networks with FEKO ports



Dual-band LPDA antenna obtained from Antenna Magus and simulated in FEKO

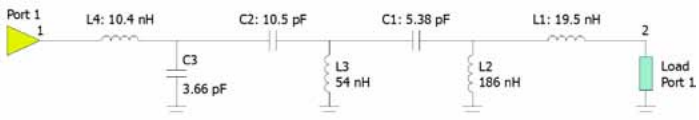
Case Study: DVB Antenna

Modern terrestrial TV transmissions make use of digital video broadcasting (DVB) technology for its more efficient use of the available radio frequency spectrum and to provide superior picture and audio quality. This example aims to design a simple DVB receiving antenna for home use in the following bands, while matching the antenna to a 50 Ω receiver impedance:

- VHF III (170-230 MHz)
- UHF IV/V (470-862 MHz)

Antenna Magus was used to identify a dual-band log-periodic dipole array (LPDA) as the appropriate antenna to use. The obtained design was imported into FEKO for simulation.

The initial impedance characteristics of the DVB antenna was submitted



DVB antenna matching circuit designed by Optenni Lab

to Optenni Lab. There appropriate matching bands were specified for a 50 Ω system impedance design optimisation. A seven-element matching network was found to perform adequately and its characteristics was returned to FEKO. The matching network is added in FEKO as a non-radiating network with no effect on the radiation characteristics of the antenna while matching its electrical characteristics.

Comparing the matched antenna's impedance to the unmatched antenna's impedance on a Smith chart in POSTFEKO, demonstrates the improved matching performance achieved by the matching circuit from Optenni Lab.

Case Study: Compact GPS and Wi-Fi Antenna

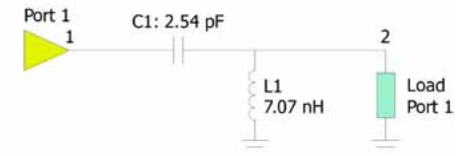
Connectivity to online communities and content sharing services are so prevalent in modern society that many devices now aim to connect straight to the web without using intermediate hardware or services. Cameras are an example of this use case, with devices emerging that can geo-stamp photos and then upload them directly to the web via Wi-Fi connections. This example seeks to design a compact antenna for such a camera and to match it appropriately for global positioning system (GPS) reception and Wi-Fi connectivity at 2.4 GHz.

Antenna Magus was used to identify a printed, planar compact broadband antenna as the antenna class of choice. This antenna measures roughly 67 mm x 18 mm x 2.54 mm and is small enough for the intended application. The initial impedance match of the antenna is reasonable in both bands, but not excellent. In order to work in these applications where low power levels are prevalent, a matching network is required to improve the impedance match.

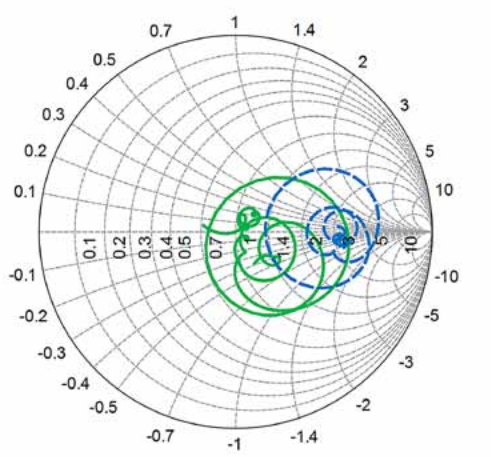
In this case Optenni Lab established that a simple two-element matching network performs sufficiently well to improve the antenna's impedance characteristics by 9.4 dB in the GPS band and by 3.19 dB in the Wi-Fi band.

Conclusions

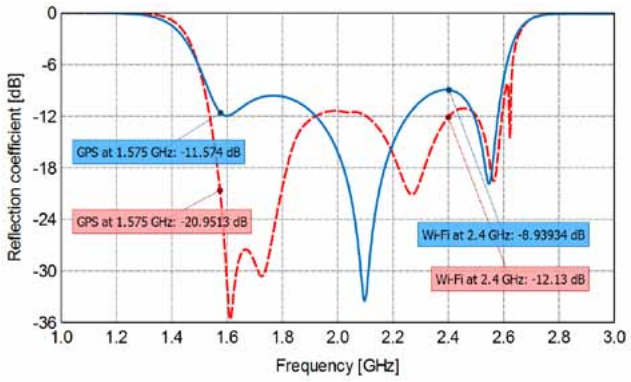
Antenna designers will find Optenni Lab's matching network designs useful in creating designs that conform to almost any impedance requirements. It is easy to use, yet powerful enough to design matching networks of up to 10 elements or even multiport matching networks. This powerful tool enables antenna engineers and system integrators to focus on optimising the electromagnetic (EM) properties of their designs while taking care of impedance matching performance with Optenni Lab.



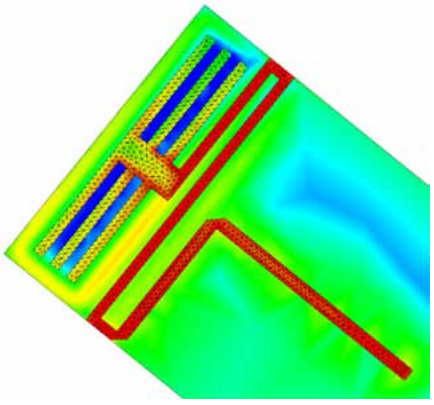
Optenni Lab matching circuit for a compact GPS and Wi-Fi antenna



Smith chart impedance of Optenni Lab matched antenna (green) vs. unmatched antenna (blue)



Reflection coefficient of Optenni Lab matched antenna (red) vs. unmatched antenna (blue)



Compact GPS and Wi-Fi antenna for camera integration

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