Key new features in SmartCtrl 2025.1

- New AC-DC converter topology: Three-Phase Vienna Rectifier.
  - In Vienna Rectifier, Control loops can also be designed in:
    - Alpha-Beta domain
    - DQ domain
  - In this new topology, different types of main filters and EMI filters can also be selected.
  - The control loop that regulates DC-Link Voltage Balancing can be designed using the solution map.

- Extended capabilities for exporting analog and digital cases of predefined topologies to PSIM and SIMBA (third-party simulators): Three-Phase Two-Level Boost rectifier and Three-Phase Vienna rectifier.

- New System Level Stability Analysis tool for allowing automatic prediction of control loop stability when the EMI filter is connected to the three-phase rectifier. This tool is available for Three-Phase Two-Level Boost rectifier and Three-Phase Vienna rectifier.

- The range of resources has been expanded: more videos and tutorials to help users get the most out of the tool.

What's new

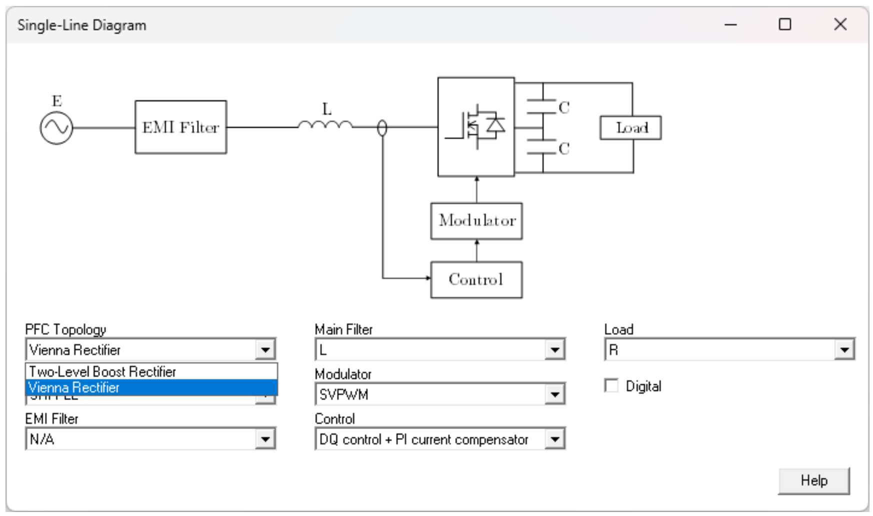
SmartCtrl 2025.1

New AC-DC converter topology: Three-Phase Vienna Rectifier

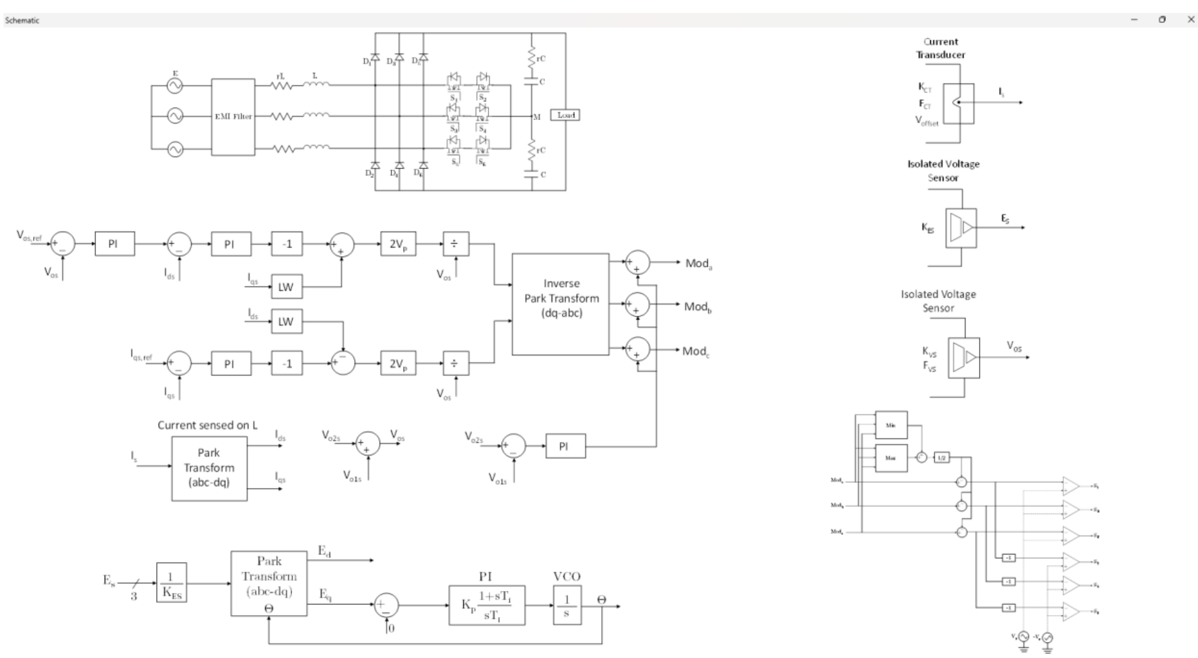
The Vienna Rectifier is a unidirectional topology of a three-level three-phase rectifier with power factor correction. This topology is characterized by high energy efficiency, low harmonic content, high power factor, and high-power density.

The Vienna Rectifier, like the Two-Level Boost Rectifier, is widely used in applications such as electric vehicle (EV) chargers, grid energy storage systems, and uninterruptible power supplies (UPS), motor drives, and telecommunication power supplies.

Now, the Single Line Diagram allows selecting whether the control to be designed is for the Vienna Rectifier or for the Three-Phase Two-Level Boost Rectifier.



SmartCtrl 2025.1 also allows designing the control loops of the Vienna Rectifier for different configurations of main filters, EMI filter, control structures, sensing stages, modulators, and loads.



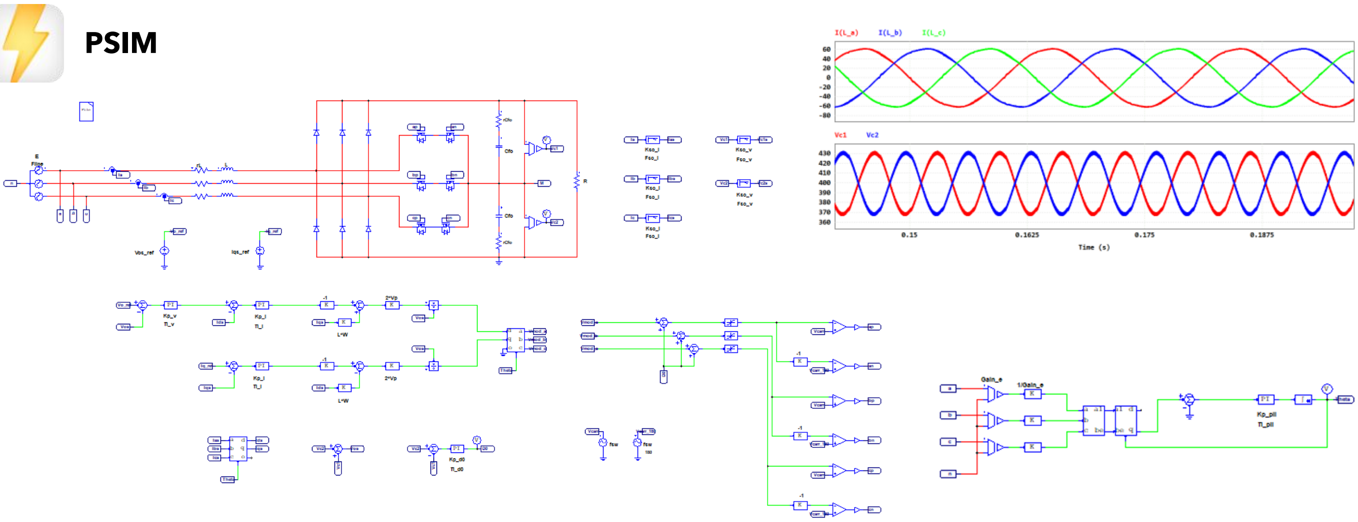
Exporting analog case of Three-Phase Vienna rectifier from SmartCtrl to PSIM and SIMBA

In **SmartCtrl 2025.1**, all the analog cases from the Vienna rectifier can be exported directly to PSIM and SIMBA.

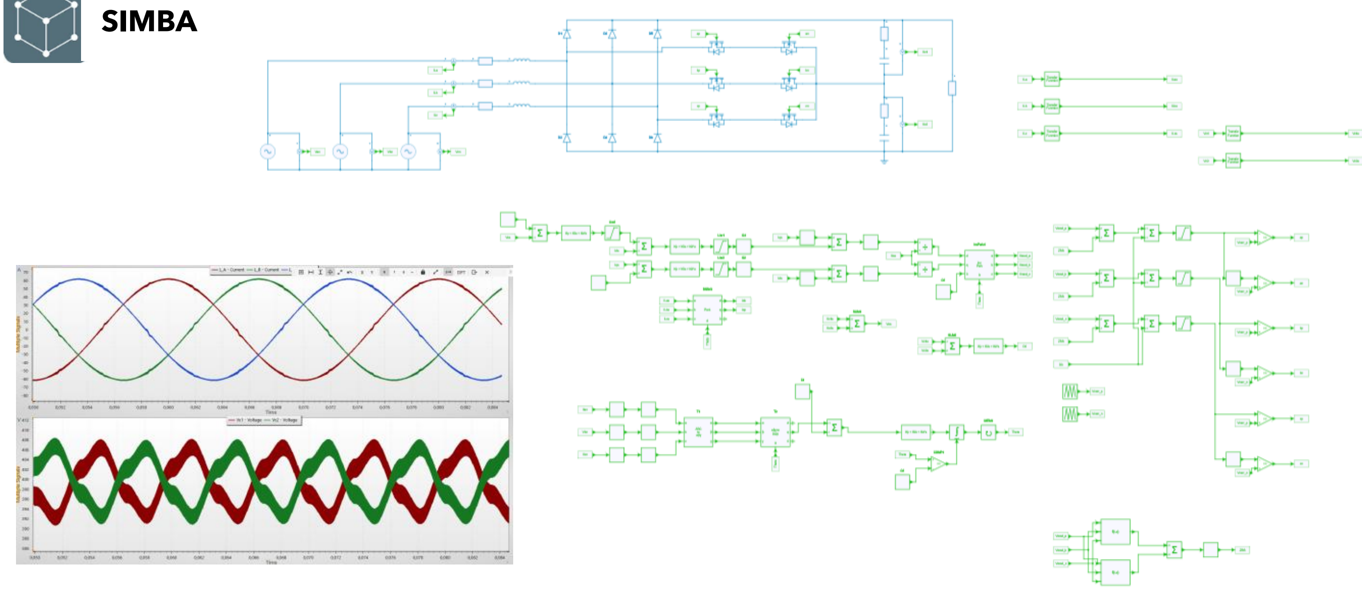
The PSIM and SIMBA simulations include the DC-Link Voltage Balancing loop.

Time domain simulations make it very simple to check whether the control loops designed with SmartCtrl are stable.

PSIM



SIMBA

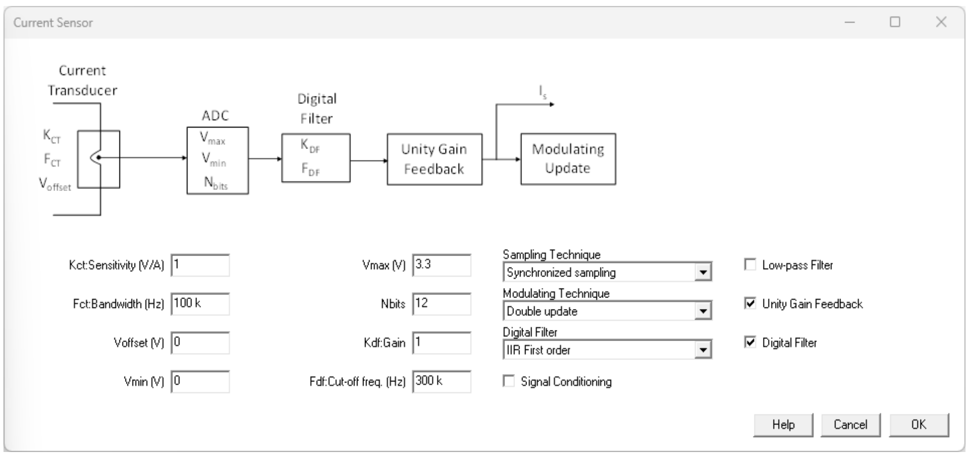


What's new

SmartCtrl 2025.1

Exporting digital cases of Three-Phase Rectifiers from SmartCtrl to PSIM

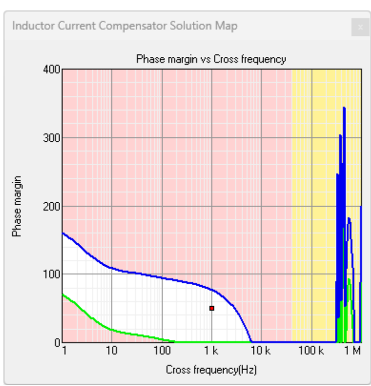
When control loops are implemented on digital platforms such as System on Chip (SoC), it is necessary to consider ADC gain, sampling techniques, and digital delays to ensure system stability.

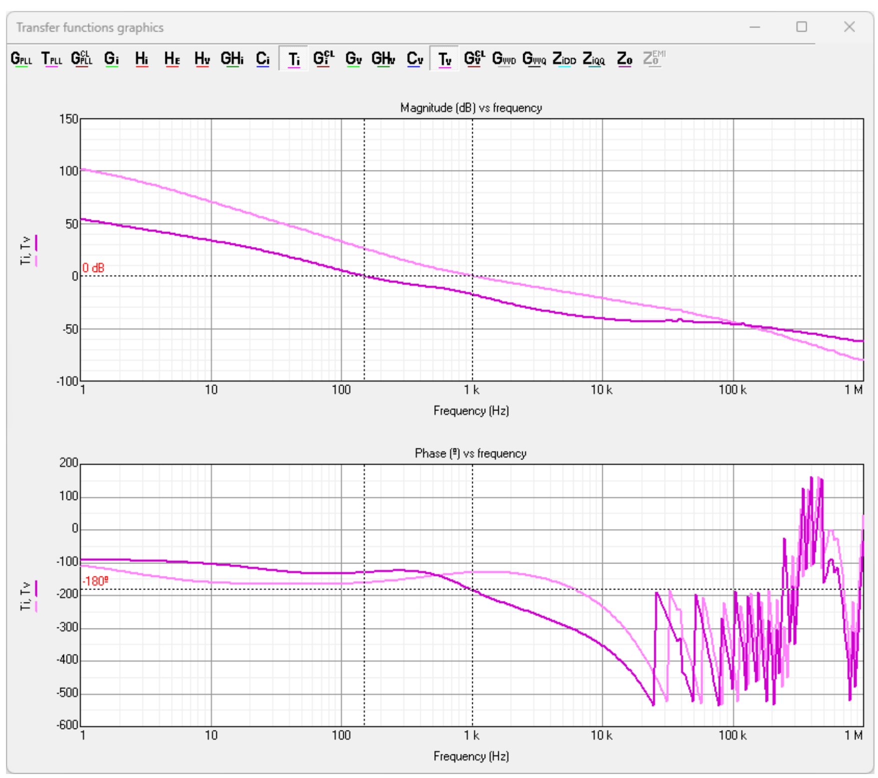


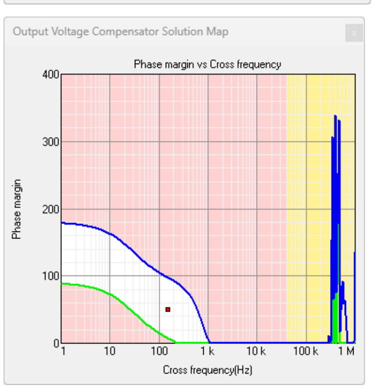
In SmartCtrl, different sampling techniques can be selected, such as synchronized sampling or oversampling.

On the other hand, in digital cases, there is the option of choosing some type of digital filter, such as: IIR First Order, IIR second Order or FIR Moving Average.

The predefined plants in SmartCtrl already include digital delay, so with the solution map, it is very simple for control engineers to adjust the bandwidths of the control loops.





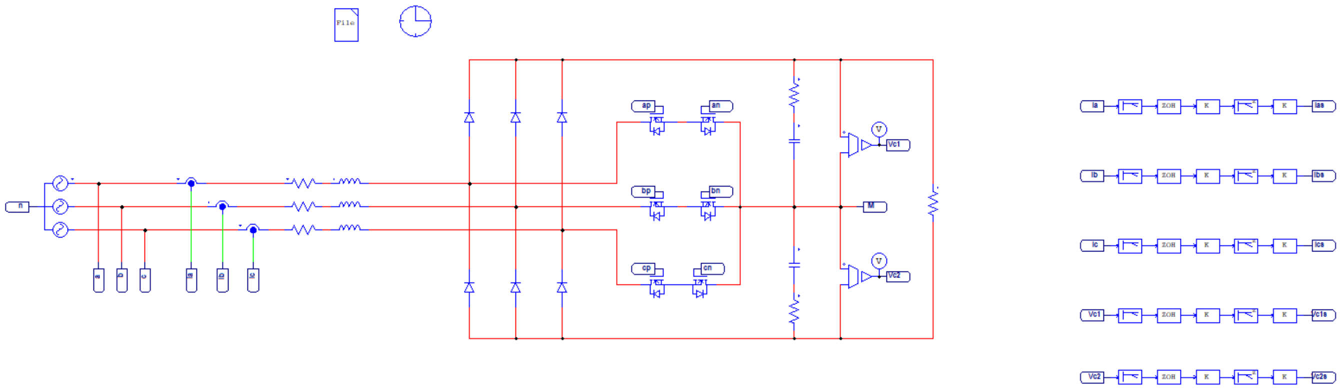


SmartCtrl 2025.1

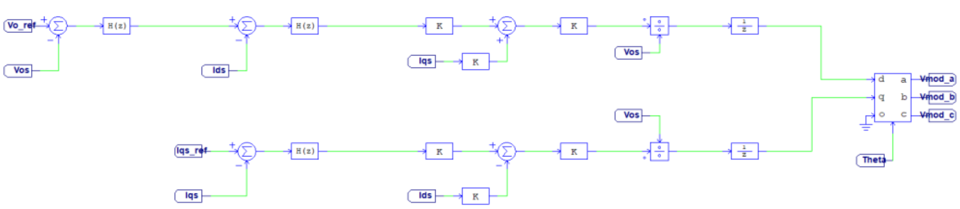
What's new

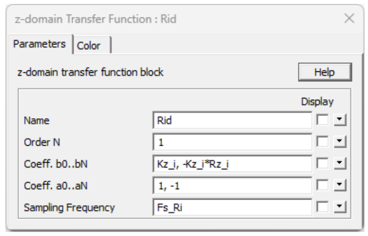
Now in **SmartCtrl 2025.1**, digital control can be exported to PSIM to check its transient response.

The sensing chains in the simulation templates include the sampling technique and digital filters defined in SmartCtrl.

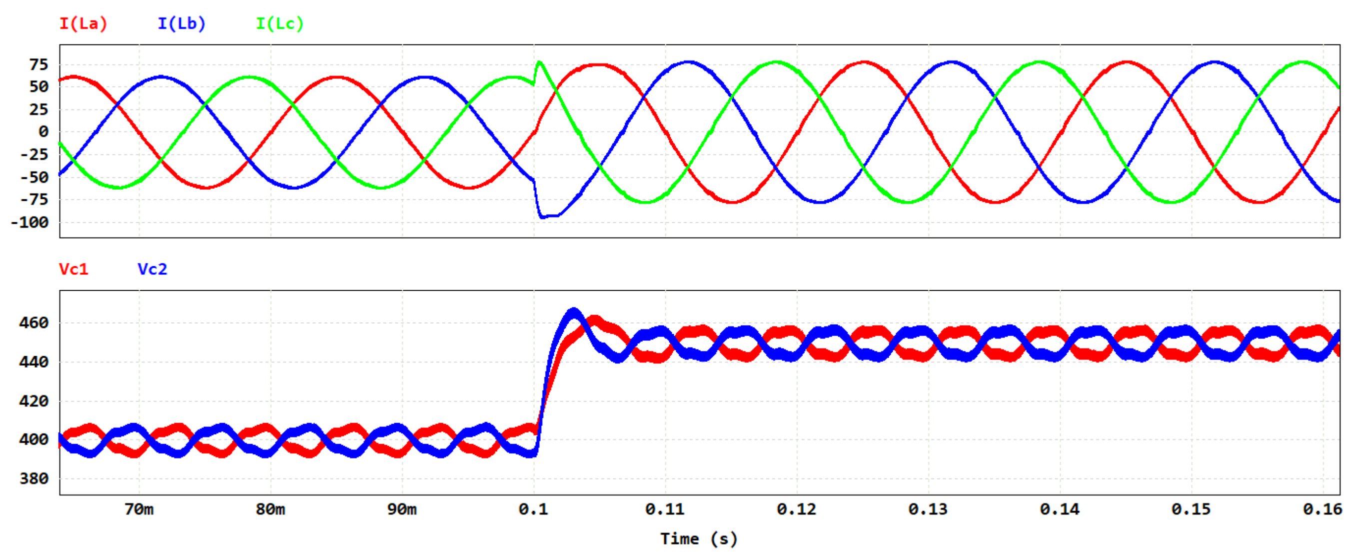


The control loops in the simulation template are implemented directly in Z-domain.





With simulation templates, it is very simple to check whether the designed control loops are stable.

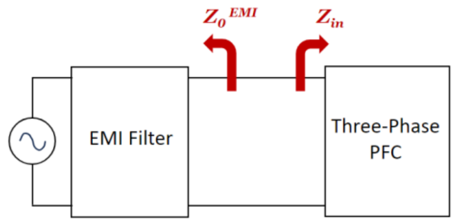


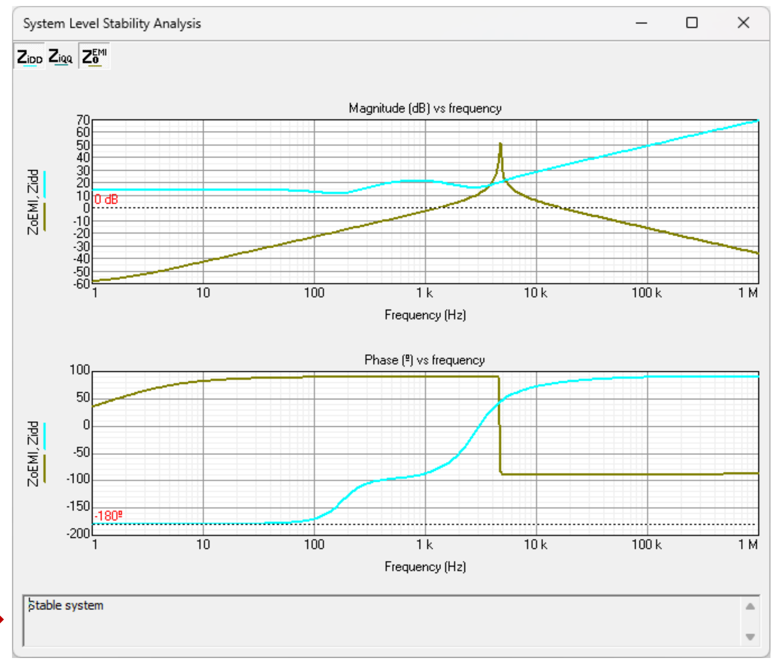
What's new

SmartCtrl 2025.1

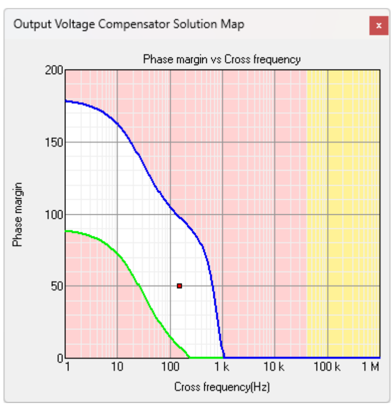
The system level stability analysis tool

It is well known that there is an interaction between the EMI filter and the regulated converter. **SmartCtrl 2025.1** includes a tool called System Level Stability Analysis, which automatically predicts the stability of control loops when the EMI filter is connected to the three-phase rectifier.

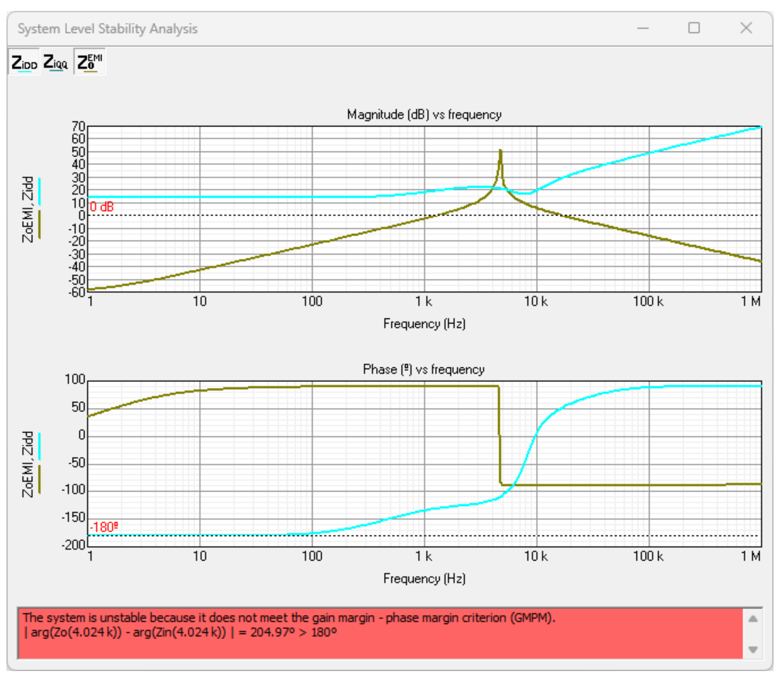




Simply by adjusting the bandwidth of the control loops with the solution map, **SmartCtrl 2025.1** can predict the stability of the system.



When a system instability is detected, the tool indicates at which point the Gain Margin and Phase Margin Criterion (GMPM) are no longer met.



Middlebrook Criterion: $\left\|\frac{Z_o^{EMI}}{Z_i}\right\| \ll 1$

The Gain Margin and Phase Margin Criterion: $\left\|\frac{Z_o}{Z_i}\right\| \le \frac{1}{GM}$ and $|\arg(Z_o) - \arg(Z_i)| \le 180^\circ - PM$