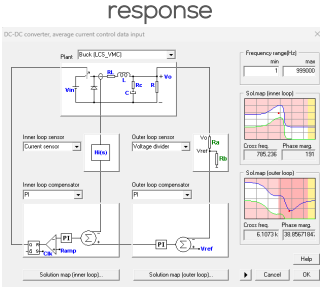
SmartCtrl

Control Design Software for Power Electronics

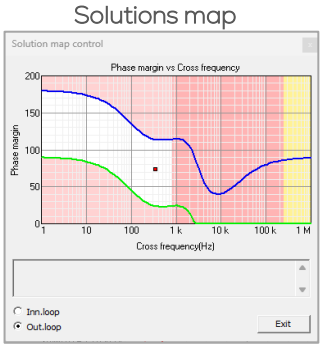
psc Power Smart Control SL

Analog and Digital Control Design for Power Electronics

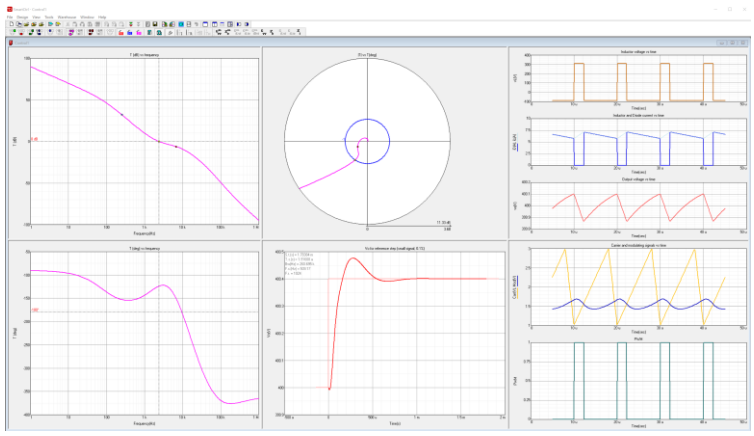
Predefined topologies, imported transfer function and frequency response



Solutions map

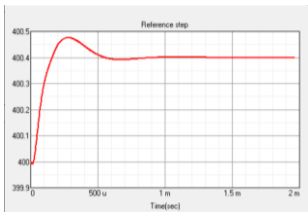


Real time updated plot and design results

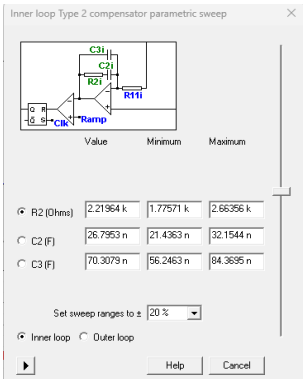


SmartCtrl allows you to easily perform a complete stability analysis of your power converter in order to perform a complete adjustment of the regulators.

Transient response



Sensitivity Analysis



Simple

- Friendly user interface
- Steady-state waveforms
- Solutions Map for easy controller design
- Interactive plots
- Seamless integration with any simulation software

Versatile

- DC-DC, DC-AC, AC-AC and AC-DC Converters
- Power Factor Correction Converters
- Equation Editor to define the transfer function
- Different Control Modes

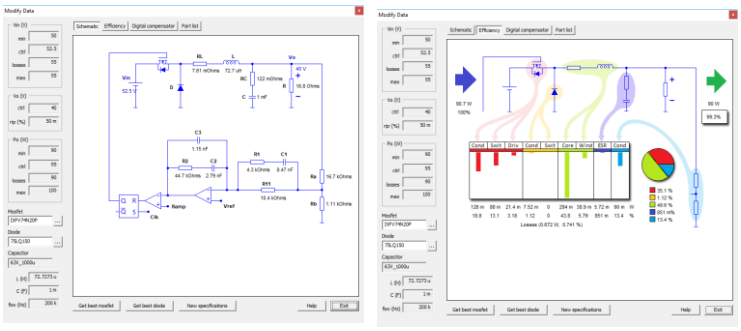
In-depth knowledge

- Multiloop control structures
- Capability to design digital controllers
- Sensitivity analysis
- Audio-susceptibility

SmartCtrl provides a perfect combination of predefined topologies and compensators, and custom designs with a powerful Equation Editor to create your own transfer functions for all elements of the power converter: plant, sensor and compensator. Import the frequency response of a system and export your control design to any simulation software.

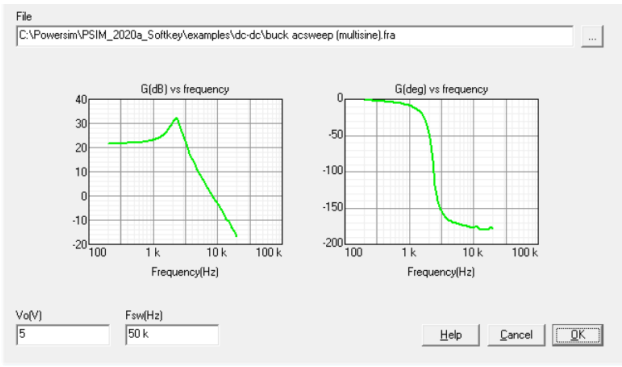
Control designs from Specifications

Starting from a specification, design quickly and visually the best control for your converter and get the results for an analog or digital control. SmartCtrl includes the complete part list with magnetics design specifications.



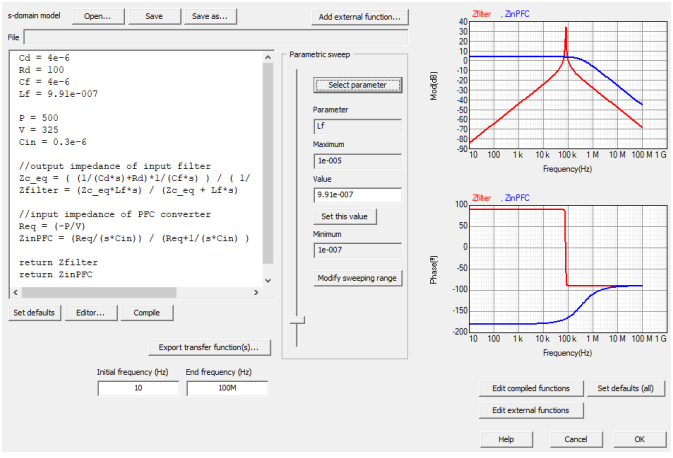
Import the frequency response

SmartCtrl has a wide set of predefined topologies for control design. It is also possible to import the frequency response of any converter, regardless of its topology.



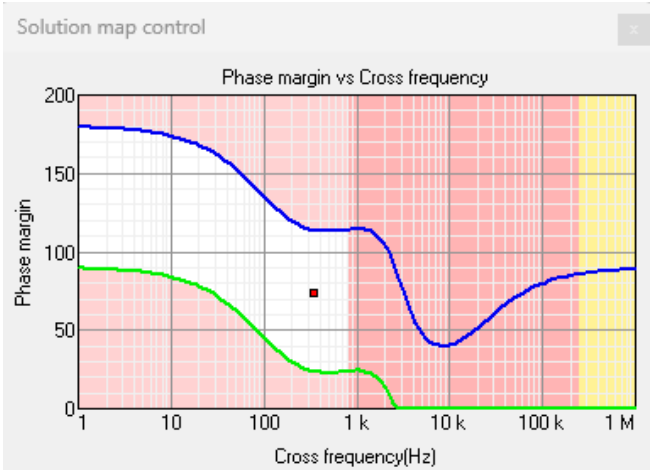
Make and Edit your own Analytical Model

Using the Equation Editor, it is possible to edit your own analytical model of any specific converter with parameter sweep capability, defining the plant, sensor or compensator.



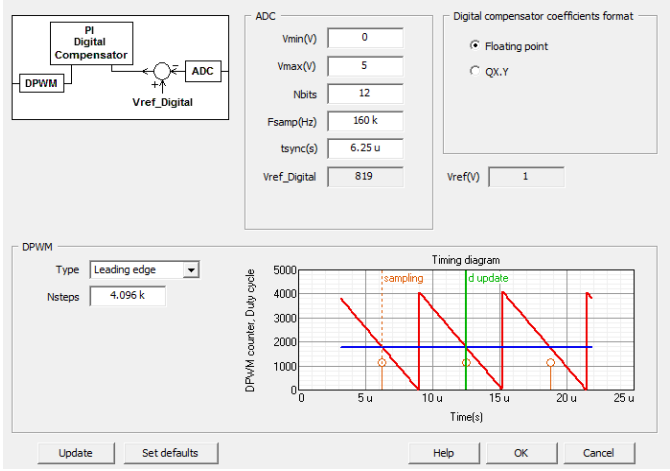
Solutions Map

Optimize your design using the solutions map. Navigate the cursor within a stable solutions space, which will aid you with the selection of the optimal design.



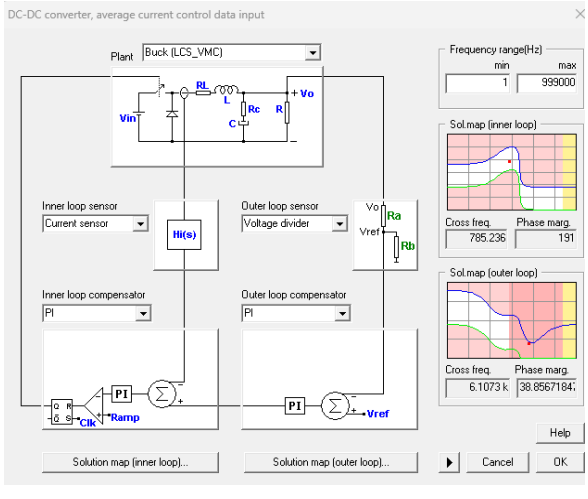
Analog and Digital Control

Just select the checkbox to define which solution you need: Analog predefined compensators (Type I, II & III PI & PID) or Digital predefined compensators (PI & PID with ADC and SPWM Effects).



Multi-loop Control Structures

Average-Current Mode Control and Peak-Current Mode Control are supported in SmartCtrl. Analyze how robust is your control.



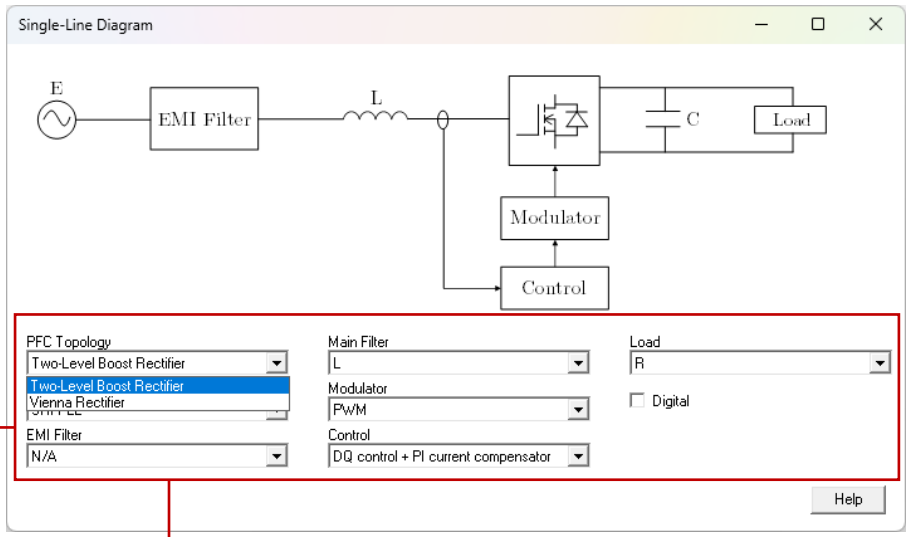
New AC-DC converter topologies:
Two-Level Boost PFC and Vienna Rectifier

The Three-phase PFC Boost Converter is a bidirectional two-level rectifier. This three-phase rectifier is frequently used in applications such as electric vehicle (EV) chargers, grid energy storage systems and uninterruptible power supplies (UPS), motor drives and telecommunication power supplies.

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.

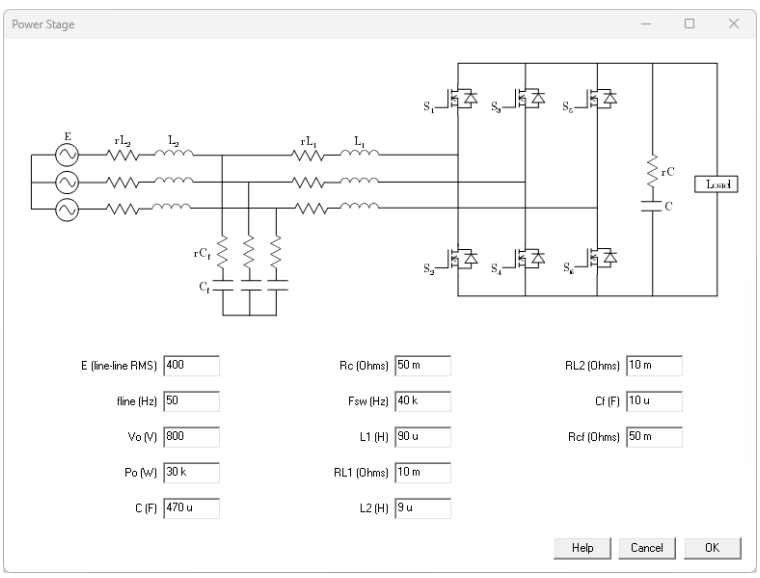
The single-line diagram window enables users to easily configure the rectifier topology, control structure, phase-locked loop, EMI filter, modulator, main filter, and load.

Just selecting the digital option, the user is able to design control loops in z-domain.

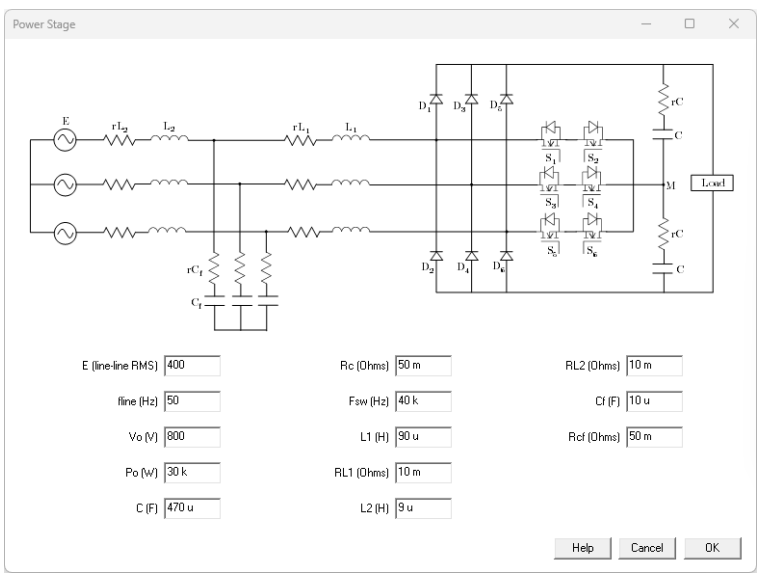


SmartCtrl 2025.1 allows to design the control loops for different types of main filters in a simple way.

Two-Level Boost PFC with LCL filter

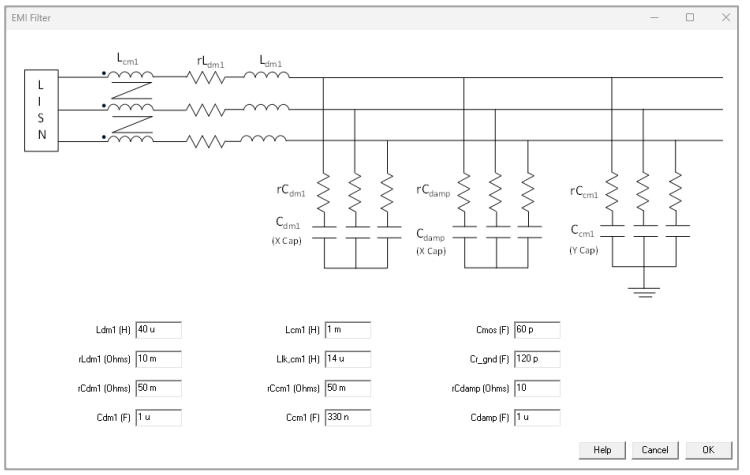


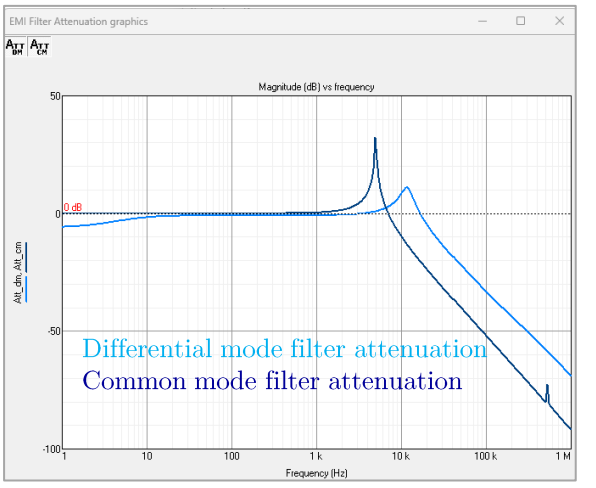
Vienna Rectifier with LCL Filter



EMI Filter

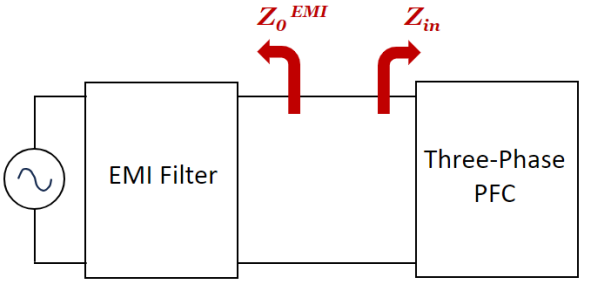
SmartCtrl 2025.1 allows the user to choose among four predefined EMI filter structures. By varying the EMI filter parameters, the attenuation achieved by the common-mode and differential-mode filter can be observed. This tool allows the user to obtain a Preliminary EMI filter design.



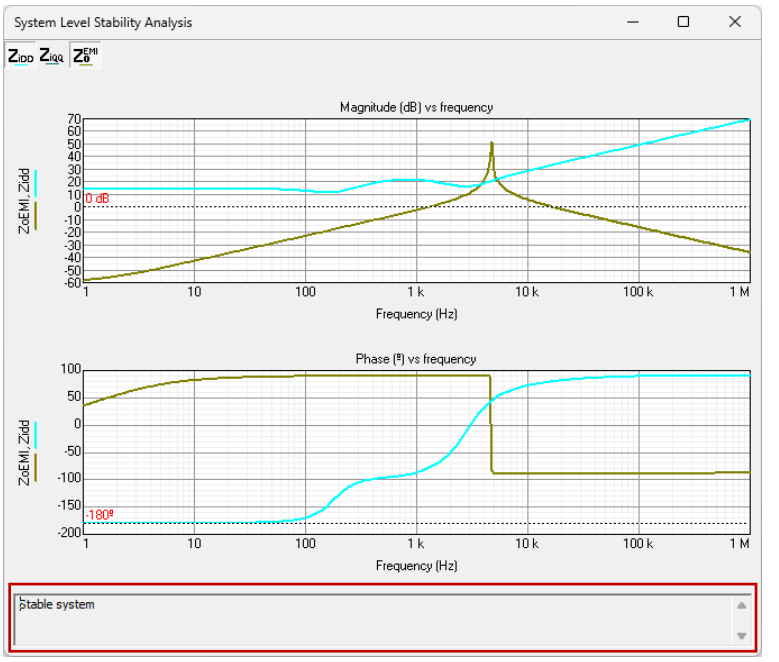


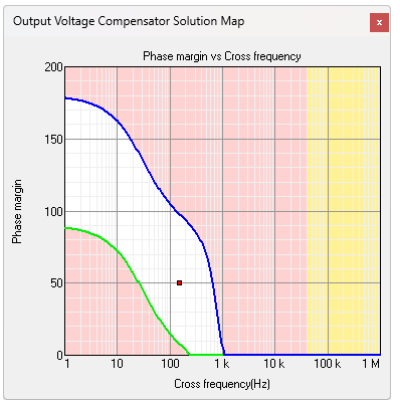
System Level Stability Analysis Tool

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.

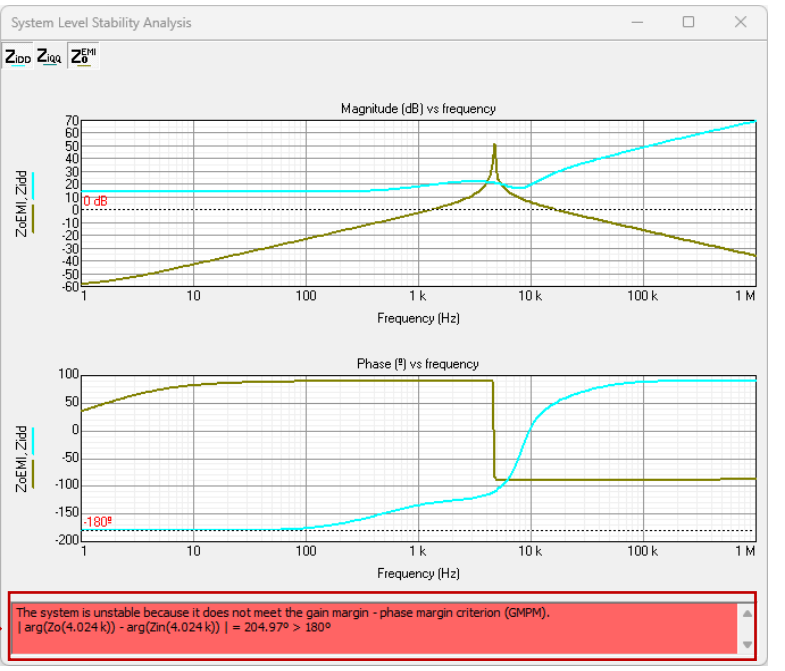


Simply by adjusting the bandwidth of the control loops with the solution map, SmartCtrl 2025.1 can predict the stability of the system.





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



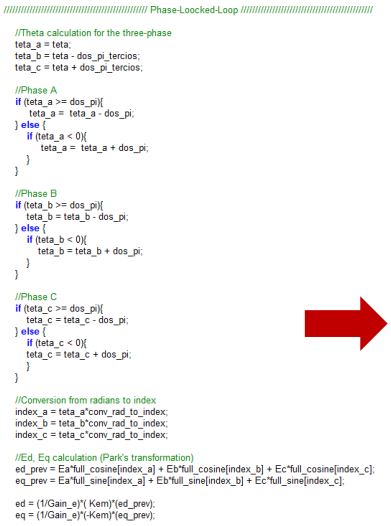
Middlebrook Criterion: $\left\| \frac{Z_o^{EMI}}{Z_i} \right\| \ll 1$

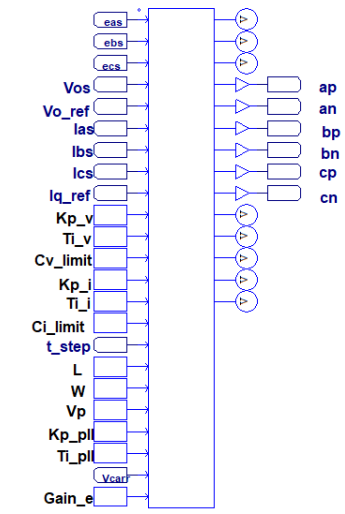
The Gain Margin and Phase Margin Criterion: $\left\| \frac{Z_o}{Z_i} \right\| \leq \frac{1}{GM}$ and $\left| \arg(Z_o) - \arg(Z_i) \right| \leq 180^\circ - PM$

Automated C-code generation

Additionally, the control design can now be exported in C code, which allows the user to have a starting template when implementing the control structure in a microcontroller or in a System on Chip SoC.





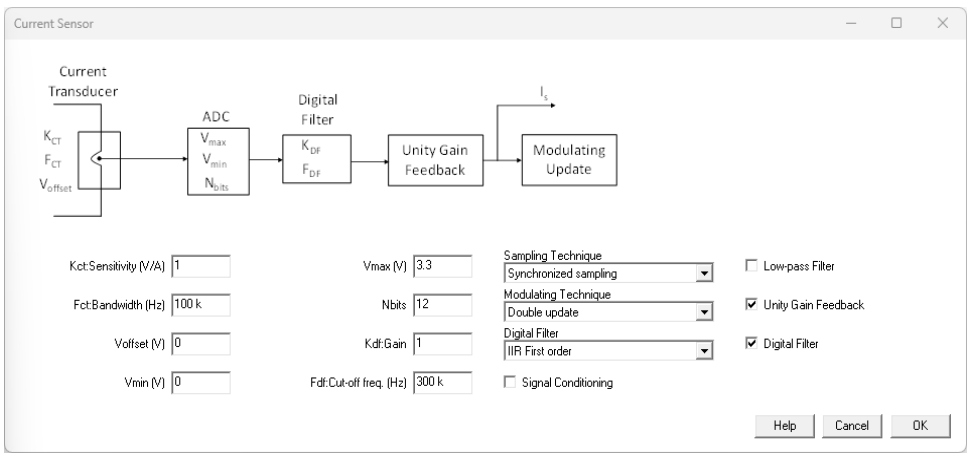


Exporting digital cases of Three-Phase Rectifiers from SmartCtrl to PSIM

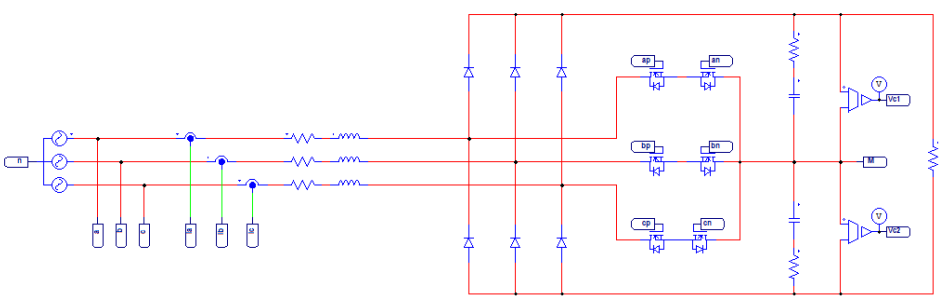
Now in SmartCtrl 2025.1, digital control can be exported to PSIM to check its transient response.

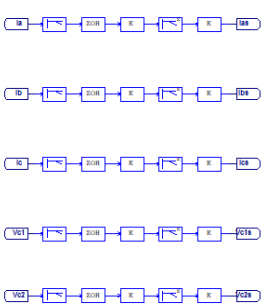
In SmartCtrl, different sampling techniques can be selected, such as synchronized sampling or oversampling.

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.

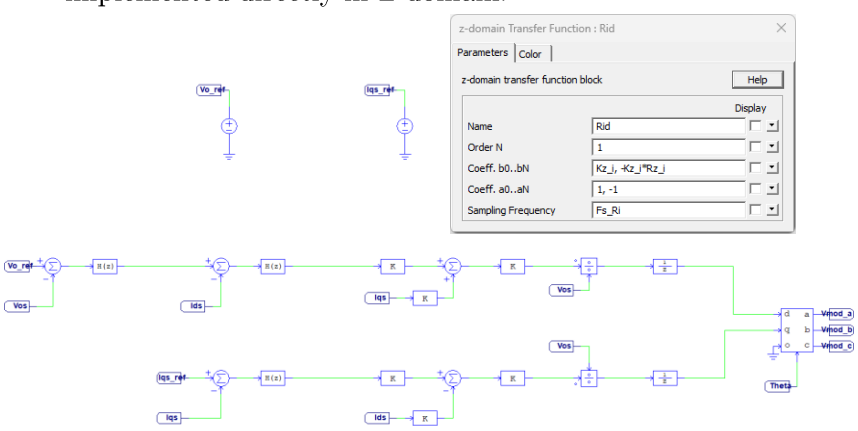


The sensing chains in the simulation templates include the sampling technique and digital filters defined in SmartCtrl.

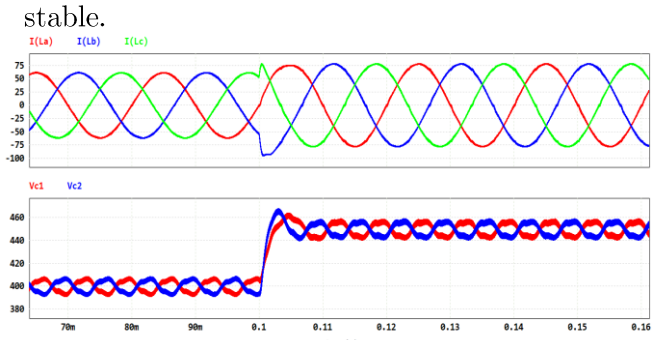




The control loops in the simulation template are implemented directly in Z-domain.



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



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