smartctrl®

The easier and faster way to design the control of your power converter
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What SmartCtrl is
What SmartCtrl is

After over 20 years of experience in the field of power electronics systems, SmartCtrl software is being developed as a platform in which, a small part of our knowledge related to control in power electronic systems, is collected.

SmartCtrl

SmartCtrl is a controller design software specifically for power electronics applications. It features:

- a friendly interface
- simple workflow
- easy to understand display of control loop stability and performance.

Using SmartCtrl, one can design controllers of various power converters easily and very quickly.

SmartCtrl Pro

SmartCtrl Pro adds the digital controller design option to SmartCtrl:

- One can design a controller in the analog s-domain, define digital delay, and check the control loop stability.
- SmartCtrl Pro allows to calculate the z-domain coefficients of digital compensators to be implemented on digital devices.

It is a good practice to compare the discretized compensator with the original analog one.
Features
From the specs to the Design

Control Designs from Specs
Starting from a specification, design quickly and visually the best control for your converter and get the results for an analog or digital control.
Multi-loop Control Structures

Average-Current Mode Control and Peak-Current Mode Control are supported in SmartCtrl:

**Average – current control**
- Inner and outer compensator design

**Peak – current mode control**
- Compensating ramp design
- High frequency effects
Data is Real Time Updated

Interactive plots allow you to choose the best control design whereas that waveforms, bodes, nyquist and all output data are updated in real time (click to see it)
Solutions Map helps the user to choose the crossover frequency and the phase margin. SmartCtrl presents a stable solutions space for every type of regulator.
Steady-state Waveforms are Plotted

Inductor current and voltage ripple are plotted

The modulating signal output ripple is also plotted
Electronic Circuit Simulator Integration

**Simulate** the final design with a single click.

SmartCtrl is seamlessly integrated with PSIM, an electronic simulator. SmartCtrl automatically generates a ready-to-simulate schematic, containing the complete circuit, including the power stage and the control circuit. With only one click on the PSIM’s icon, one can export the entire circuit and simulate it.
Import Frequency Response

Get the frequency response of your power converter from a simulator or frequency analyzer, import it to SmartCtrl and design your control.
Capabilities
Import

If you want to check your theoretical model or view the effects produced by modifying certain parameters of your converter or control, you can import transfer functions.
Export

Right clicking on any of the sub-screens, you can export the information you need: transfer functions, waveforms and transient responses.

Besides, from the export-global menu, you can export all you want, just by selecting the desired options. The numerical data of every transfer functions (plant, open loop gain, closed loop gain, etc.) and transient plots can be exported to PSIM, Mathcad, Matlab, Excel, etc. via a txt file.
For every DC-DC converter and control type, the transfer functions (TF), output voltage to input voltage (Audio-susceptibility) and output voltage to output current (output impedance) are shown as additional Bode Plots. These TF are very interesting for system converters. E.g. power distribution in satellites, etc.

There are many available transfer functions:

- Open-loop audio susceptibility
- Closed-loop audio susceptibility
- Open-loop output impedance
- Closed-loop output impedance
- Open-loop input impedance
- Closed-loop input impedance
Sensibility Analysis

With **Parametric Sweep** you can perform a **sensitivity analysis** on every parameter of the **plant**, **sensor** and **regulator**. Observe how this change affects the system. Data is real time updated.

- Input and output voltages
- Converter inductance, filter capacitor, cap ESR, etc.
- Output power
- Switching frequency
- Sensor gain and bandwidth
- Regulator resistors and capacitors
Compensator Design and Synthesis Algorithms

Design your control by the **K method**. From the desired MF and fc the frequency of the zeros and poles is calculated. ...and optimize the control by the **K plus method** or manually. Choose the poles and zeros frequency of the compensator with the cursor of your mouse.
Get the Digital Control

The key features of the Digital Control module are the following:

- **Digital effects** (DEFs) such as sampling frequency, DPWM delays, and rounding effects due to the limited bits number of compensator coefficients are considered.
- **New Bode plots** considering DEFs are shown.
- **Sensitivity analysis** of DEFs can be performed.
- The designed **digital compensator** can be exported to PSIM in z-domain format.
Topologies and Control Modes

In SmartCtrl you can design the control for a generic converter or use a predefined topology.

The predefined topologies are:
- Forward converter
- Flyback converter
- Buck converter
- Boost converter
- Buck-boost converter

For each predefined topology or generic converter you can choose the following controls:
- Voltage mode control
- Average current mode control
- Peak current mode control
Power Factor Correction tool

SmartCtrl has the **PFC design tool** (Power Factor Correction – Boost Converter). This tool incorporates an UC3854A controller as well as some other practical information, like the actual values of output voltage when a single pole regulator is used as outer loop compensator.
The Equations Editor

This built-in function supports the definition of customized plants and sensors transfer functions, through the “design a generic plant” and “design a generic control system” options.

Design the plant of your power converter anywhere in s-domain and use SmartCtrl to design its control.

```matlab
// Buck (Power Stage)
R = 4.35e6
L = 30e-6
C = 160e-6
Vin = 12

// Control to output transfer function
Gvd = Vin/(L*C*s*L/(L/R)+(s+1))
return Gvd
```
Why SmartCtrl
SmartCtrl, a friendly interface, simple workflow, and easy to understand display of control loop stability and performance

Simple
Friendly user interface
Steady-state waveforms
Solutions Map for easy controller design
Interactive plots
Seamless integration with PSIM

Versatile
DC-DC Converters
Power Factor Correction Converters
Different Control Modes
Any converter control can be designed

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