March 2023

SIMPLIS AC Analysis of PFC Circuits Using New PFC POP Trigger

+ What's New in 9.1

APEC 2023

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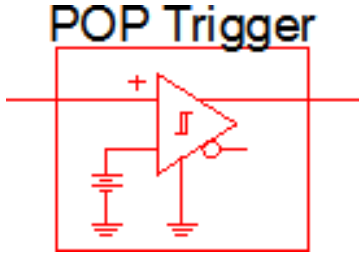
Overview

- POP and AC Analysis of PFC Rectifier Circuits using the new **PFC POP Trigger Schematic Device** (available in upcoming release **9.1c**)

- What's new in SIMetrix/SIMPLIS 9.1
  - currently released version: **9.1b**

SIMPLIS POP and AC

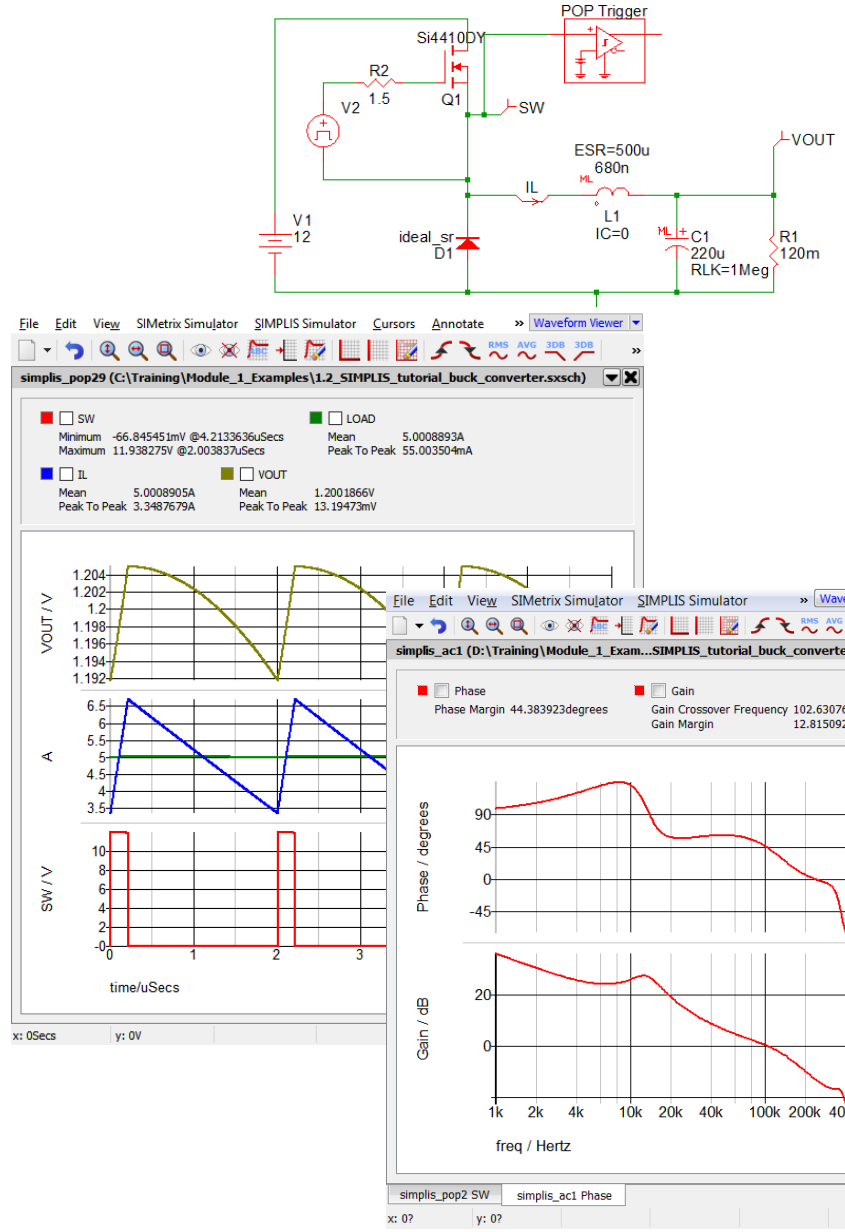


- **Periodic Operating Point** (POP) Analysis in SIMPLIS is used to find the steady-state operating point of a converter

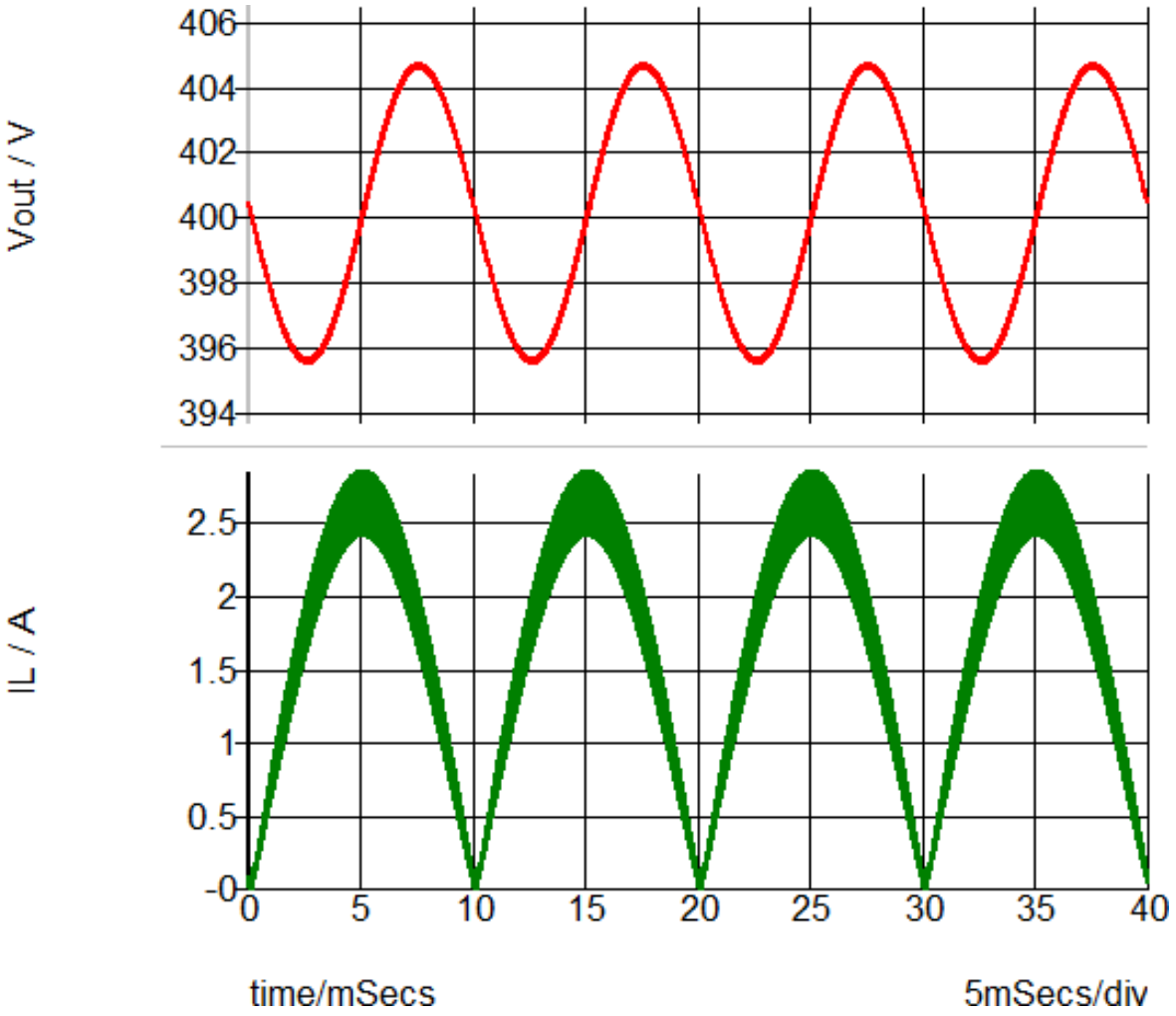
- A successful POP Analysis is **required** in order to undertake an **AC Analysis** in SIMPLIS to generate Bode plots of the system

- Both of these are fully **time-domain** simulations

- Works straightforwardly usually for DC-DC converters



POP and AC for PFC Circuits



- For AC-DC converters:
  - POP period is now the (half) line cycle
  - For POP to succeed, the switching frequency must an **integer multiple** of the line frequency

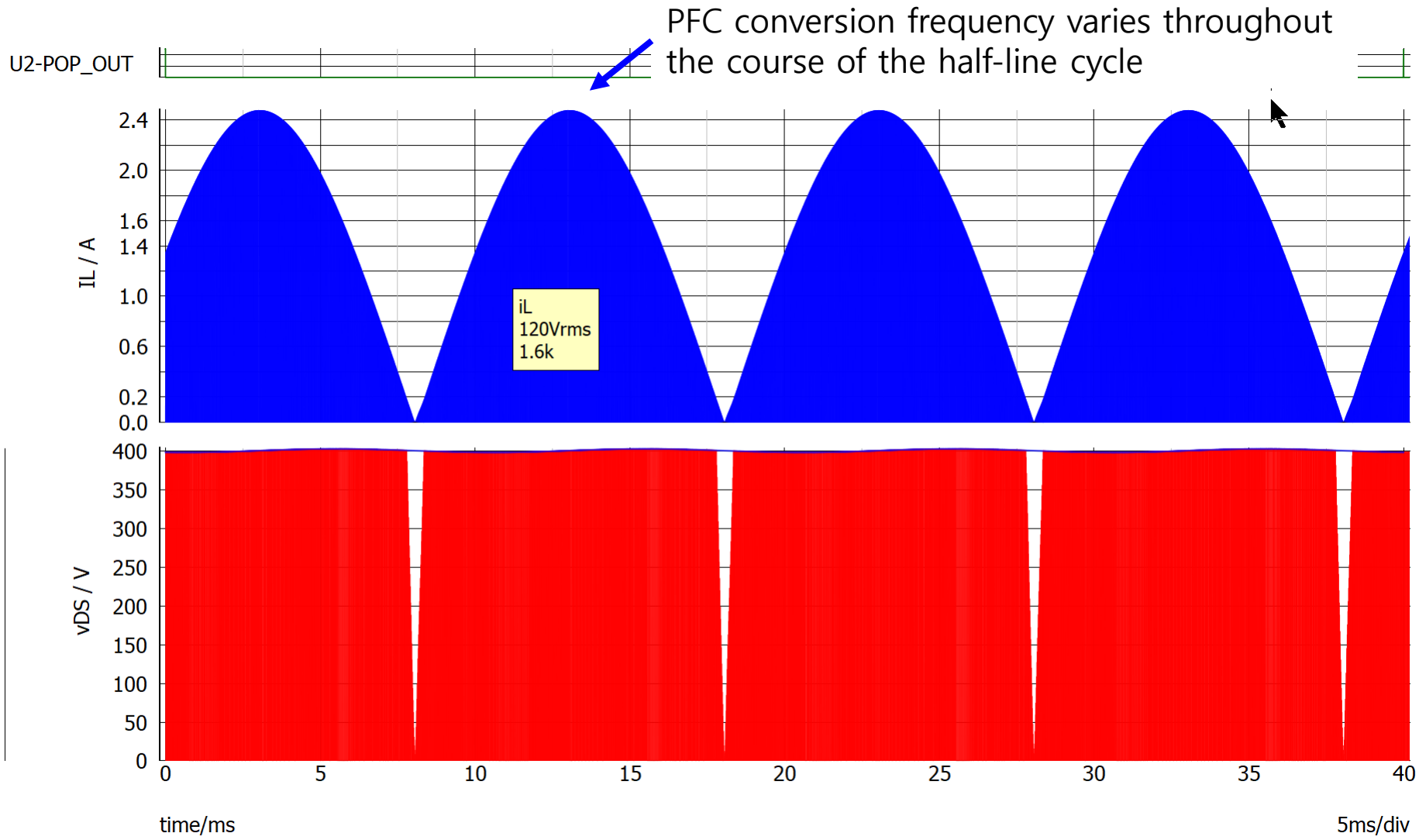
i.e. we need a whole number of conversion cycles per AC line cycle

- not guaranteed in a real system

Example: 100 W CCM PFC

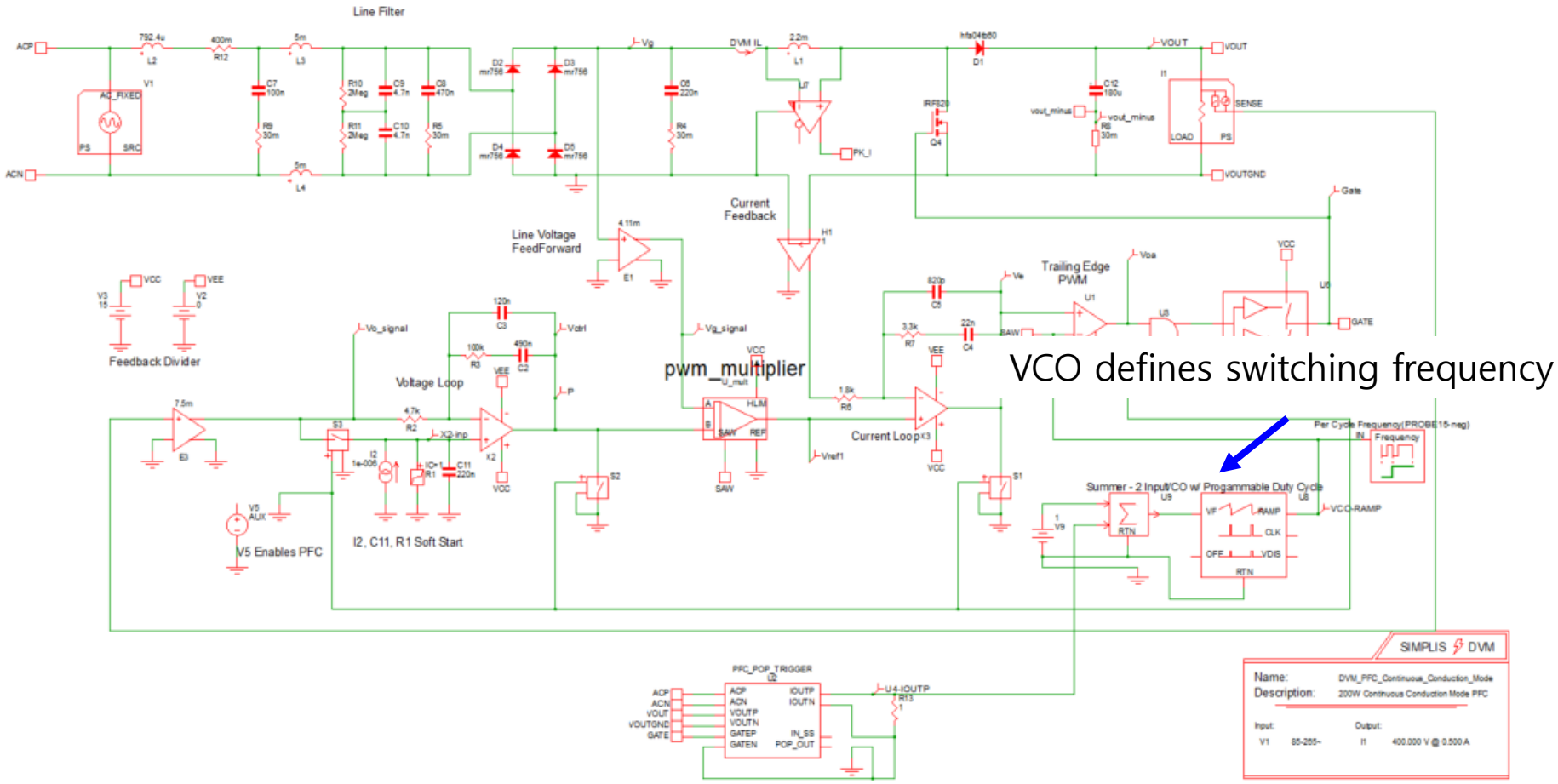
- Number of switching cycles per line cycle varies with load current
- You might get 3560.7 or 3561.2 switching periods per line period instead of a nice round 3561

  -> POP will fail
- No POP, no AC



Example: 200 W CFM PFC

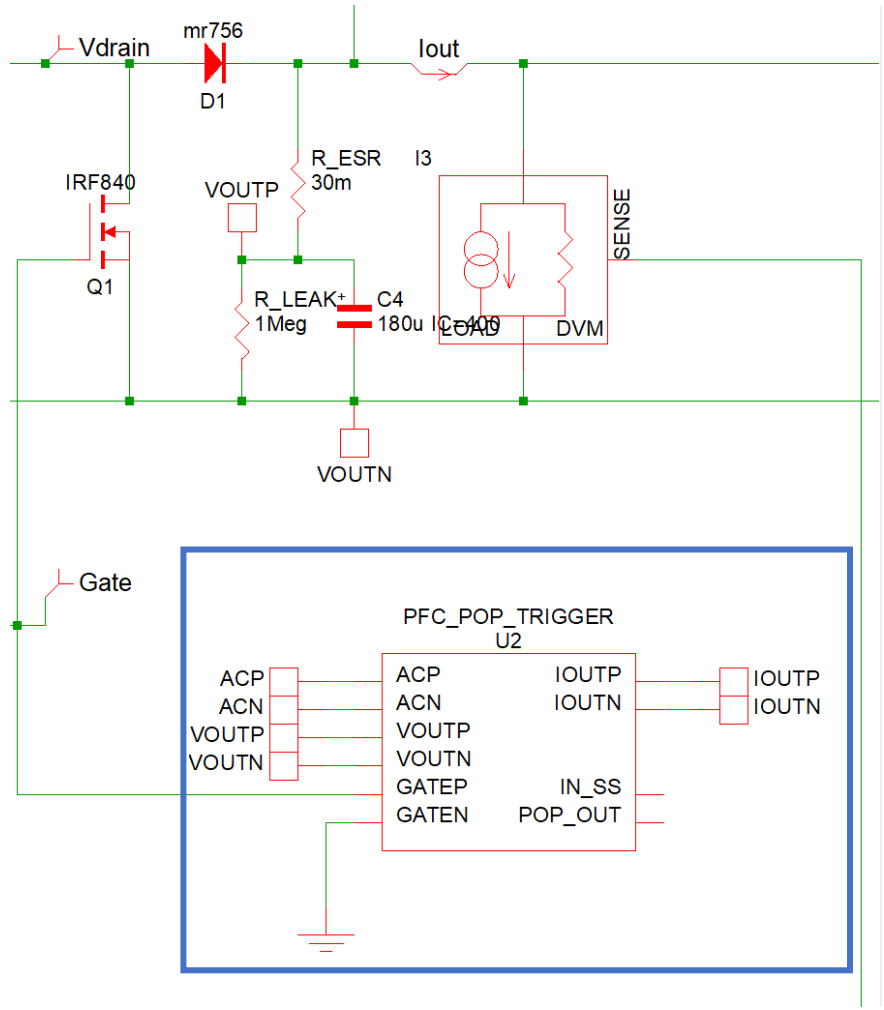
- Line cycle is 50 Hz
- Oscillator might produce a switching frequency of e.g. 99.867 kHz instead of 100 kHz
  -> POP will fail
- No POP, no AC



To solve this problem: PFC POP Trigger (v.9.1c+)

- **SIMetrix/SIMPLIS ver. 9.1c** will introduce the new **PFC POP Trigger Schematic Device**

- What does it do?
  - In CCM example: adds a few µA to the output load to make sure that the line and switching frequency are synchronized
  - In CFM example: adds a few nA to oscillator charge current to make sure switching frequency is exactly 100 kHz



PFC POP Trigger Usage

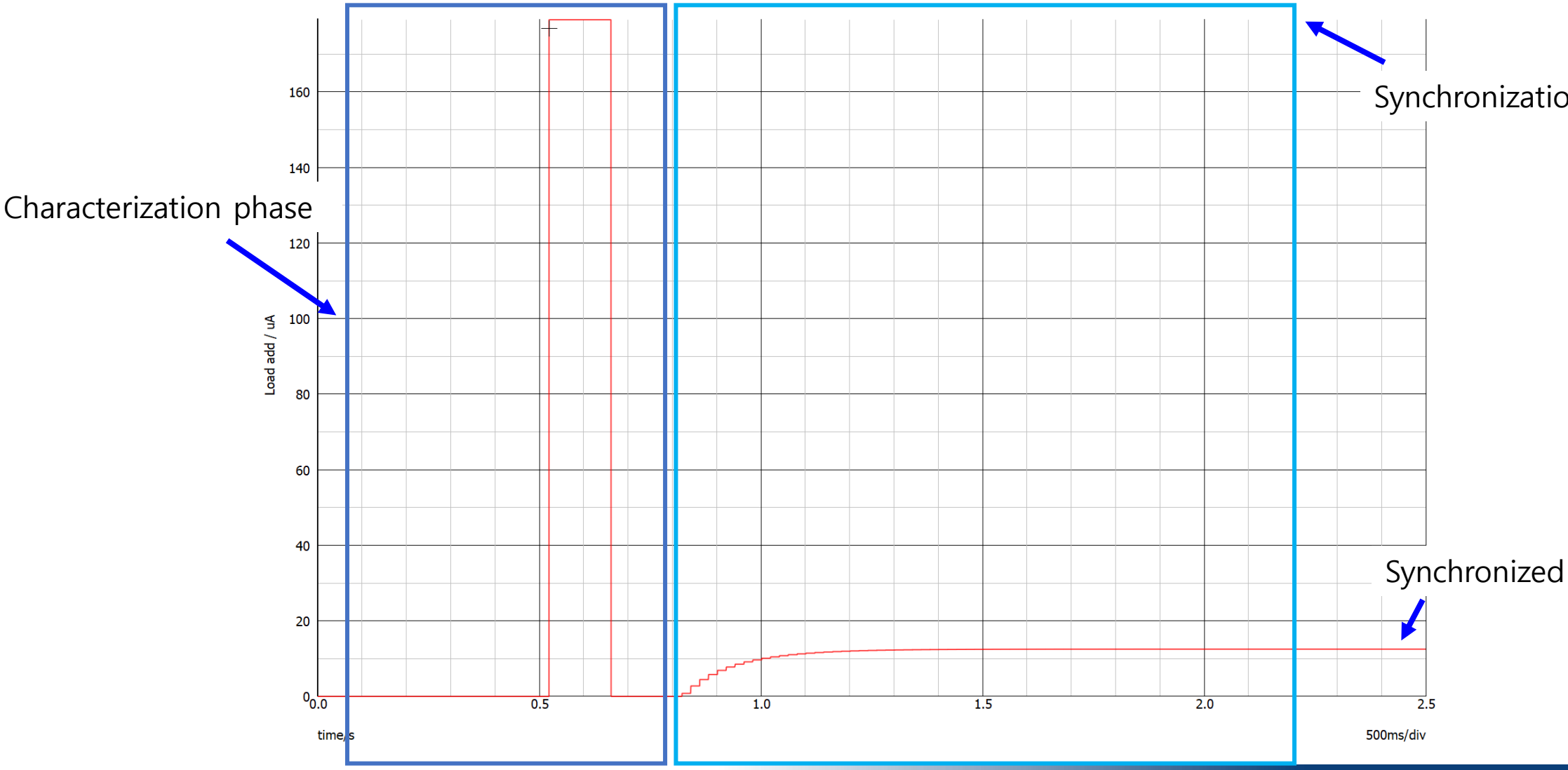
- To use the PFC POP Trigger, **run a transient, and then POP + AC**

- During transient, PFC POP Trigger does
  1. **Characterization**: determines the relationship between the PFC POP Trigger output and the switching frequency of the circuit, which then enables:

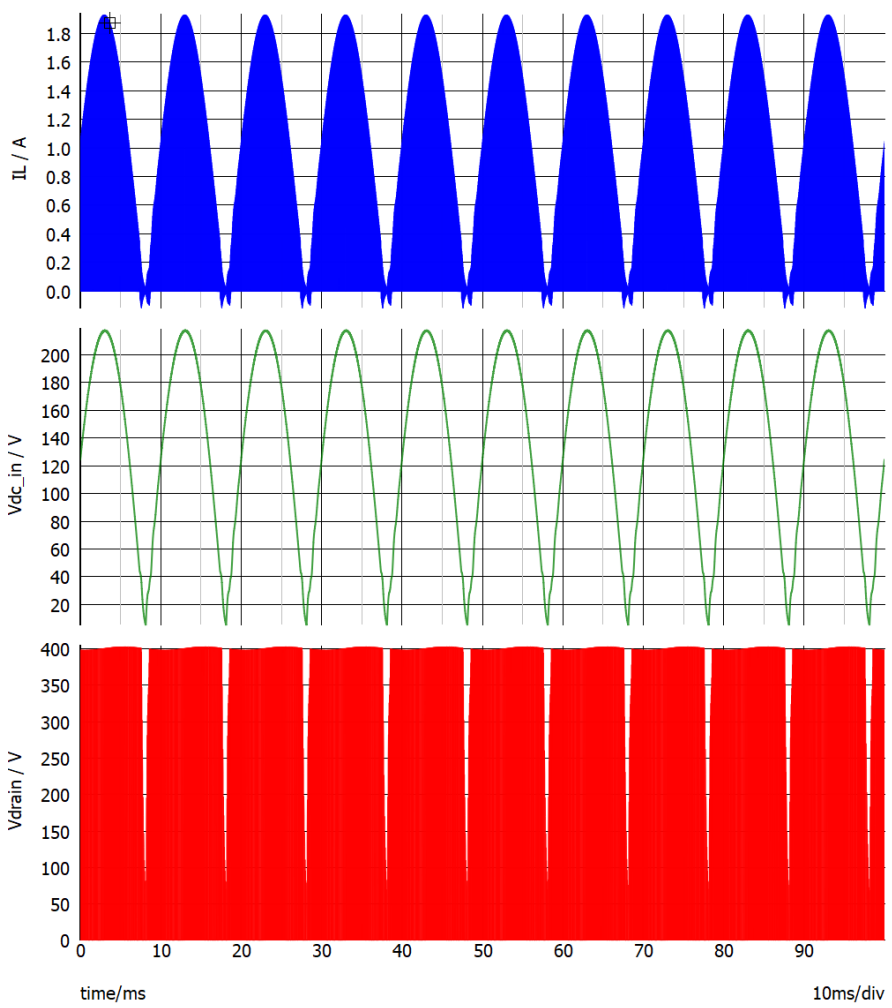
  2. **Synchronization**: finds the value of the output of the PFC POP Trigger that synchronizes the AC line and switching frequency of the circuit

- With the results of the synchronization subsequently the PFC POP Trigger is used to:
  3. **Perform a successful POP and AC analysis**.

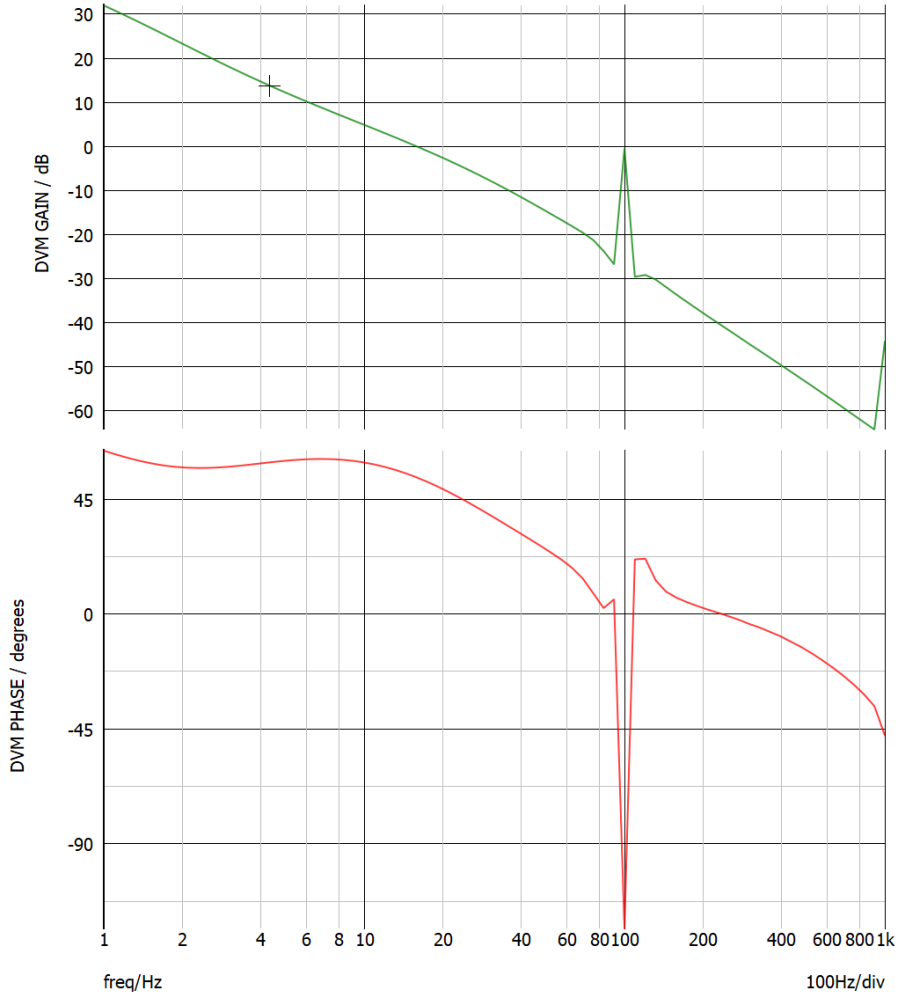
PFC POP Trigger Output Current – Transient Analysis



PFC POP Trigger Output Current – POP & AC



POP Analysis Results

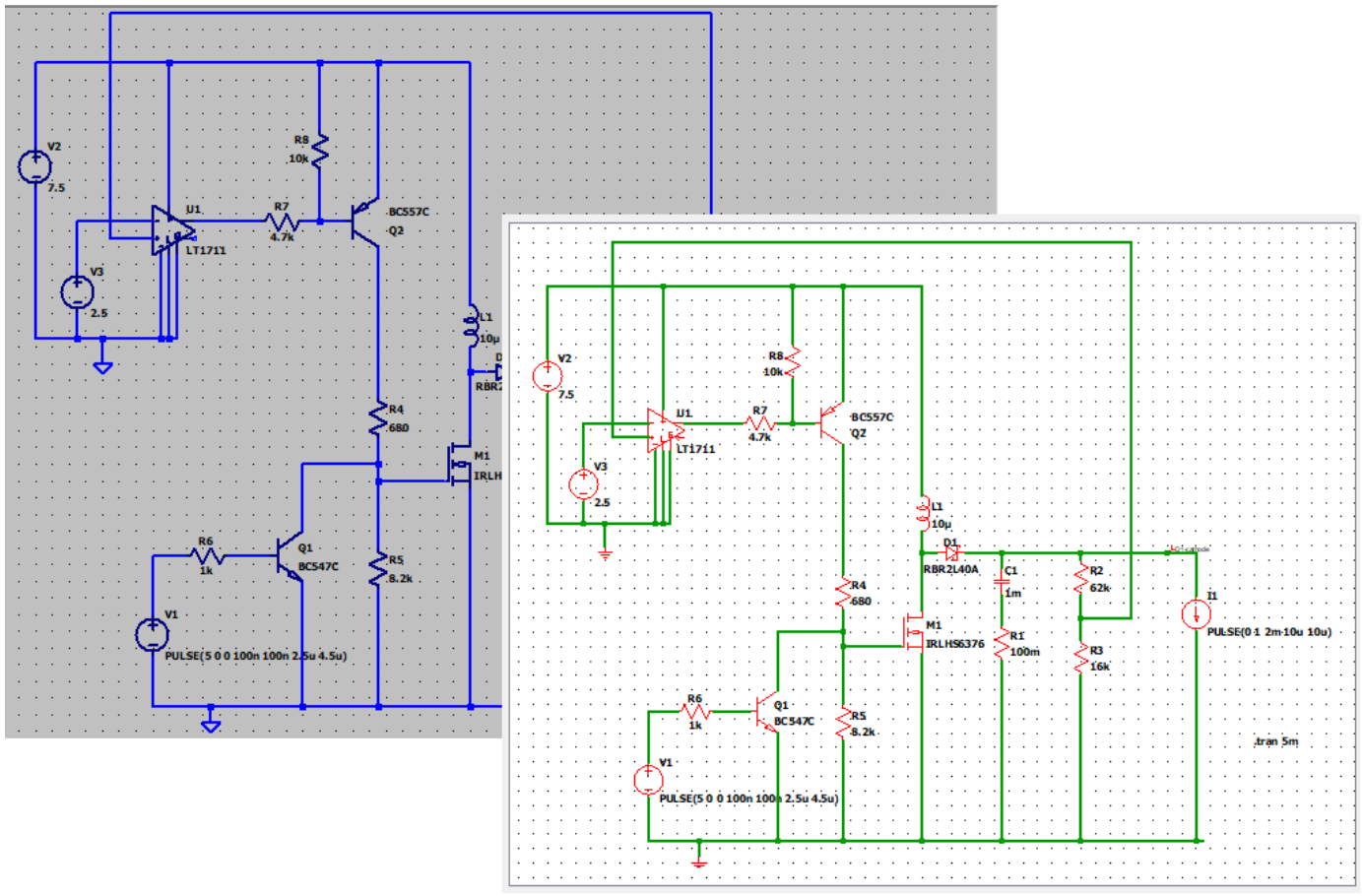


AC Analysis Results

What's New in 9.1

LTspice® Compatibility

The schematic editor can now open LTspice® schematics directly; just open the file in the normal way. If all models used are supported by the SIMetrix simulator, a simulation on the schematic can be run with only minimal changes required.

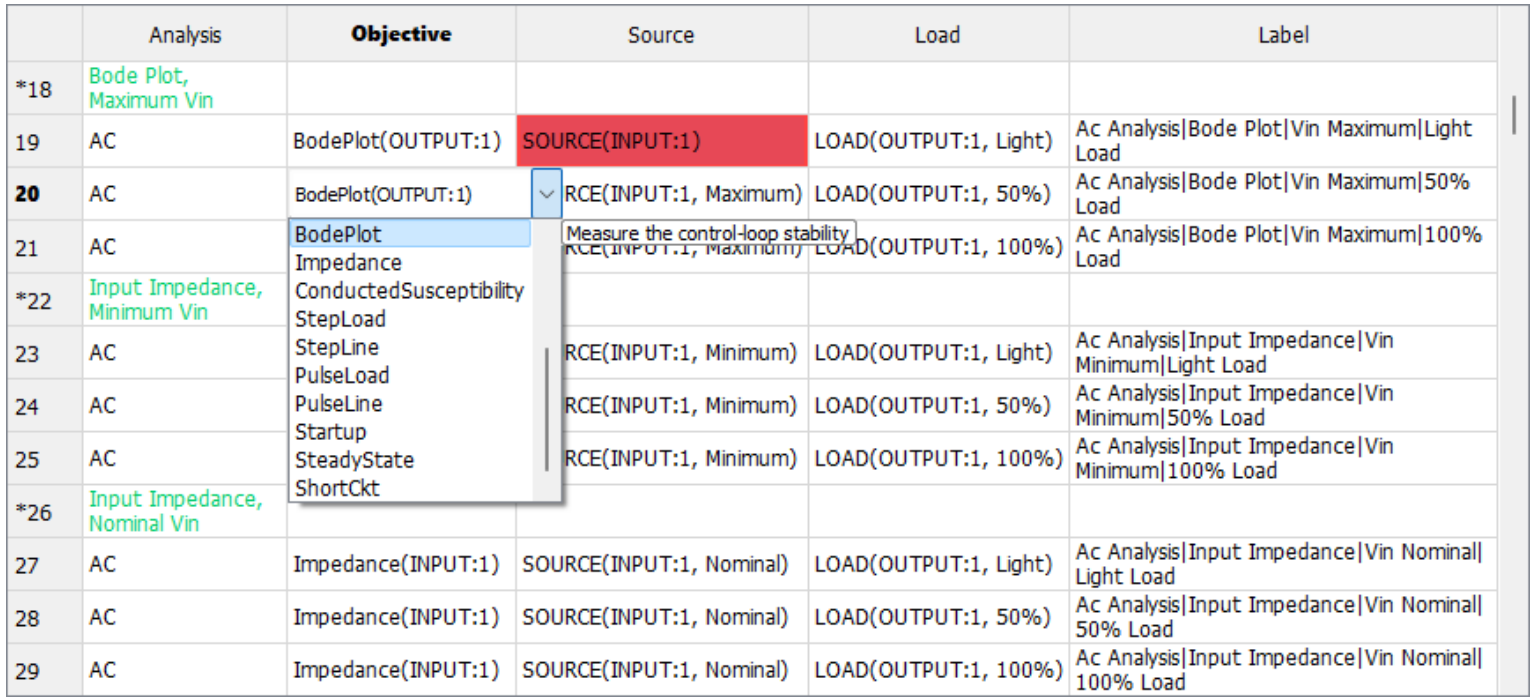


What's New in 9.1

DVM Testplan Editor

Testplans can now be created and edited using the built-in Testplan Editor. Along with removing the need for third-party spreadsheet or text editor software, the built-in Testplan Editor also provides assitance with various cell inputs. This includes drop-down selection lists and argument entry assistance.

In addition to cell entry assistance, the Testplan Editor also provides real-time error checking. Hover over colored cells to receive further infor mation.



What's New in 9.1

DVM Testplan Wizards

Testplan wizards will allow the dynamic creation of a DVM testplan that includes only user-desired Objectives and circuit inputs and outputs.

Three Wizards are available:

- DC-DC 1 Input 1 Output
- DC-DC 1 Input 2 Output
- AC-DC 1 Input 1 Output